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Association between fish oil consumption and the incidence of mental health issues among active duty military personnel

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THESIS

ASSOCIATION BETWEEN FISH OIL CONSUMPTION AND THE INCIDENCE OF MENTAL HEALTH ISSUES AMONG ACTIVE DUTY MILITARY PERSONNEL

by

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March 2016

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13. ABSTRACT (maximum 200 words)

There is increasing attention from the military to understand the potential benefit of enhancing service members' meals with omega-3 nutrients to improve their overall mental health. This research warrants attention due to the increase in the number of military members returning from wars with mental health issues such as PTSD and depression, and an increasing number of military members who are medically discharged for these mental health issues. Using the 2011 DOD Health Related Behaviors Survey of Active Duty Military Personnel, we analyze the association between fish oil consumption and mental health outcomes. This analysis focuses on three outcomes that capture a service members' state of mental health (depression, post-traumatic stress [PTS], suicide ideation), and whether service members sought mental health therapy within the past 12 months. We estimated logistic regression models where the key independent variables were various levels of fish oil use (none [reference group], light, moderate, and daily use). For each outcome, we estimated five models that include control variables in the following categories: demographics, combat exposure, lifestyle—activities, lifestyle—nutrition, and lifestyle-stress. In addition, we estimated a model on the Navy-only population to examine whether Navy personnel might exhibit different patterns than DOD as a whole. We also explore whether there are gender differences in the association between fish oil usage and mental health outcomes. The survey did not show higher fish oil consumption to be associated with lower incidences of depression, post-traumatic stress, or suicide ideation among all the services. Navy-only analysis has similar findings, except that one of the models indicated that light fish oil use lowered the likelihood of Navy personnel experiencing high PTS in the past 30 days. Our recommendations are to analyze the survey data across all years it has been given to see if there are trends, encourage the military to place more emphasis on lifestyle choices pertaining to health and nutrition, and urge the military to help service members with stress and anxiety.

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There is increasing attention from the military to understand the potential benefit of enhancing service members' meals with omega-3 nutrients to improve their overall mental health. This research warrants attention due to the increase in the number of military members returning from wars with mental health issues such as PTSD and depression, and an increasing number of military members who are medically discharged for these mental health issues. Using the 2011 DOD Health Related Behaviors Survey of Active Duty Military Personnel, we analyze the association between fish oil consumption and mental health outcomes. This analysis focuses on three outcomes that capture a service members' state of mental health (depression, post-traumatic stress [PTS], suicide ideation), and whether service members sought mental health therapy within the past 12 months. We estimated logistic regression models where the key independent variables were various levels of fish oil use (none [reference group], light, moderate, and daily use). For each outcome, we estimated five models that include control variables in the following categories: demographics, combat exposure, lifestyle—activities, lifestyle—nutrition, and lifestyle-stress. In addition, we estimated a model on the Navy-only population to examine whether Navy personnel might exhibit different patterns than DOD as a whole. We also explore whether there are gender differences in the association between fish oil usage and mental health outcomes. The survey did not show higher fish oil consumption to be associated with lower incidences of depression, post-traumatic stress, or suicide ideation among all the services. Navy-only analysis has similar findings, except that one of the models indicated that light fish oil use lowered the likelihood of Navy personnel experiencing high PTS in the past 30 days. Our recommendations are to analyze the survey data across all years it has been given to see if there are trends, encourage the military to place more emphasis on lifestyle choices pertaining to health and nutrition, and urge the military to help service members with stress and anxiety.

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LIST OF ACRONYMS AND ABBREVIATIONS

AA	Arachidonic Acid
ALA	Alpha-Linolenic Acid
APA	American Psychiatric Association
BMI	Body Mass Index
DHA	Docosahexaenoic Acid
DOD	Department of Defense
EPA	Eicosapentaenoic Acid
ICD-9	International Classification of Diseases
MPTE	Manpower Training and Education
MRE	Meal, Ready to Eat
NIMH	National Institute of Mental Health
PTS	Post-Traumatic Stress
PTSD	Post-Traumatic Stress Disorder
TMA	Tricare Management Activity

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This thesis is in memory of one of the most amazing women I was fortunate to know and love, my Grammy, Henrietta Emmeline Robinson LaRou.

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I. INTRODUCTION

In mid-2011, 100,000 U.S. military members were deployed to Afghanistan and at the peak of the Iraq War, 170,000 troops were deployed (Tomei, 2015, p. 1). These troops understood the potential risks of the deployments, but did not think they personally would be the ones to return changed. The families of these service members and the American population have seen these deployments be beneficial to some and detrimental to others. It is the detrimental deployments of our military members that require particular attention. With "1.6 million U.S. troops deployed to the wars in Iraq and Afghanistan" from 2001–2008, RAND researchers found 300,000 of them have returned with reported symptoms of Post-Traumatic Stress Disorder (PTSD) and depression (RAND, 2008, p. 1). According to the research conducted by RAND, many of these service members who are suffering from PTSD and depression do not seek the much-needed help for fear that their careers will be terminated (RAND, 2008, p. 1). Of the ones who do seek help, they report the care is "minimally adequate," which poses potential societal problems of unemployment, and marriage and drug issues (RAND, 2008, p. 2). Mental health conditions are not a fading issue; in fact, they are becoming more prevalent, and warrant a serious investigation into potential solutions that can help our service members and society.

A. BACKGROUND

According to the U.S. Department of Veterans Affairs, the American Psychiatric Association (APA) formally recognized the mental health concept, PTSD, when adding the term to the third edition of the Diagnostic and Statistical Manual of Mental Disorders in 1980 (Friedman, 2015a). The National Institute of Mental Health (NIMH) defines PTSD as a mental health condition that "develops after a terrifying ordeal that involves physical harm or the threat of physical harm in which a person's fight or flight response is either damaged or changed" (NIMH, 2015, p. 1). This condition usually involves excessive anxiety, insomnia, and possible depression and is caused by an individual's genes and brain chemistry (NIMH, 2015, p. 1). Though risk factors are often

physiologically based, environmental factors may also lead to an increased risk of developing PTSD (NIMH, 2015, p. 2).

Another mental health condition involving the brain chemistry of an individual is depression. According to the National Institute of Mental Health there are three types of depression: Major Depression, Persistent Depressive Disorder, and Bipolar Disorder (NIMH, 2015). Major Depression involves “interference with the ability to work, sleep, eat, study, and enjoy life” and can occur in one singular episode or numerous episodes in a person’s life (NIMH, 2015). Persistent Depressive Disorder is identified by a “depressed mood that lasts for at least two years” while Bipolar Disorder is “cycling mood changes from extreme highs to extreme lows” (NIMH, 2015).

In researching PTSD and depression in the U.S. military, one cannot help but wonder what alternatives there are in the fight against these mental health issues. Research has been rich in identifying anti-depressants, cognitive-based therapy, and psychotherapy treatments for mental health issues, but what about more natural approaches (NIMH, 2015)? Over the past years, more and more mental health research is focusing its efforts on omega-3 fatty acid and its use in the treatment of mental health related conditions. What is omega-3 and how could it possibly help with PTSD and depression? According to Harvard Public Health Nutrition Source, T. H. Chan (2015):

> Omega-3 fatty acids are an integral part of cell membrane throughout the body and affect the function of the cell receptors in these membranes. They provide the starting point for making hormones that regulate blood clotting, contraction and relaxation of artery walls and inflammation. They also bind to cell receptors in cells that regulate genetic function. (p. 1)

Omega-3 and omega-6 are both unsaturated fatty acids that have double Carbon bonds (Bloch & Hannestad, 2012, p. 1). When the double bond is in the third position it is called omega-3 and when the double bond is located in the sixth position it is called omega-6 (Bloch & Hannestad, 2012, p. 1). Omega-3 is known for its anti-inflammatory response while omega-6 produces inflammation in the body (Bloch & Hannestad, 2012, p. 1).

Unlike other fats the human body can naturally make, omega-3 and omega-6 polyunsaturated fatty acids cannot be produced in the body and must come from the foods consumed or from nutritional supplements (Lewis et al., 2011, p. e1). Omega-3 is further divided into three main categories: Eicosapentaenoic Acid (EPA), Alpha-Linolenic Acid (ALA), and Docosahexaenoic Acid (DHA) and "are selectively concentrated in neural tissues and are required for optimal neural function" (Lewis et al., 2011, p. e1). EPA and DHA predominately come from fatty cold water fish and supplements (i.e., fish oil) while ALA comes from fresh green leafy vegetables, flaxseeds, flaxseed oil, walnuts, and some grass-fed meat (Chan, 2015, p. 1). Since most American diets are deficient in the natural consumption of fatty cold water fish, numerous omega-3 supplements (i.e., fish oil) have been introduced in the market. When comparing supplements, one's primary concern is to compare not the total fish oil dosage on the front of the bottle but the amount of EPA and DHA in the supplement (Freuman, 2014).

Both omega-3 and omega-6 fatty acids are critical nutrients for the body in regard to brain function and development, but they must be consumed in balance (University of Maryland Medical Center, 2013, p. 1). Unlike a Mediterranean diet that has a balance of omega-6 and omega-3 fatty acids, most "American diets tend to contain 14–25 times more omega-6 fatty acids than omega-3 fatty acid" (University of Maryland Medical Center, 2013, p. 1). Since Americans easily consume the necessary amount of omega-6 fatty acid from the consumption of seeds, nuts, refined oils, many may have an imbalance of omega-3 to omega-6 levels (University of Maryland Medical Center, 2013, p. 1). For example, "to achieve a 50/50 balance of n-3 HUFAs to n-6 HUFAs in blood and tissues, 2178 mg/d of n-3 HUFAs are needed when the background diet contains 8.91 en% of omega-6 LA, but only 133 mg/d of n-3 HUFAs when the diet contains .8 en% of omega-6 LA" (Hibbeln & Gow, 2014, p. 121). Researchers Montain and Jonas (2014) have found that when omega-6 levels are excessively higher than omega-3 levels in an individuals' body, this can lead to adverse health conditions regarding cardiovascular disease, improper immune function, suicidal risk, depressions, and improper inflammatory response (Montain & Jonas, 2014, p. 1).

PTSD and depression are not only a medical concern for our U.S. military but an economic and manpower concern as well. Our service members are at the heart of this conversation, and their health and well-being are directly linked to retention and accession rates of the military. With no end to the wars in Iraq and Afghanistan in sight, Hibbeln and Gow (2014) conducted a study in which they found that mental health issues are on the rise among military personnel returning from these wars. They estimate that "35 percent of Iraqi war veterans accessed mental health services in the year after returning home and 12 percent per year were diagnosed with a mental health problem" (Hibbeln & Gow, 2014, p 117). With the rise in our service members seeking post-deployment medical attention for PTSD and depression, these wars are costing our country $6.2 billion in military medical expenses, lost productivity, and suicides during the two years after the military member returns from deployment (RAND, 2008, p. 1). According to Carmona (2014), $2.5 trillion is spent on health care yearly and for every one dollar we spend on healthcare, seventy-five cents is spent on preventable chronic diseases (Carmona, 2014, p. 179). The military needs to find an economically responsible medical solution to combat PTSD and depression so that we may keep our most productive and optimally-trained military members retained. Maybe that medical solution just might be something natural that has been there all along?

B. RESEARCH OBJECTIVE

The U.S. military is a subset of American society, with service members experiencing many of the same medical and health issues that are common among civilians. Adverse mental health diagnoses have recently grown in frequency with most mental health problems involving the brain chemistry that controls the emotional and psychological well-being of an individual (Mayo Clinic, 2015). While there are many mental health conditions—PTSD, depression, suicide, anxiety, schizophrenia, and obsessive compulsive disorder, to name a few—this thesis focuses on the conditions of depression, post-traumatic stress, suicide ideations, and mental health therapy.

Currently, most of the research to date with regard to PTSD and omega-3 is based on civilians. The current research tests for a relationship between omega-3 and outcomes

such as PTSD, depression, and suicide using the following techniques: human studies, surveys, and quantitative analysis. This thesis will be different in that it uses a military-focused population to analyze the correlation between fish oil use and the incidence of mental health issues that include depression, post-traumatic stress, suicide ideation, and mental health therapy. The population of focus in this thesis is active duty military personnel who participated in the 2011 Department of Defense (DOD) Health Related Behaviors Survey of Active Duty Military Personnel. The following research questions are analyzed from the survey results of 39,877 active duty service members from the Army, Navy, Air Force, Marine Corps and Coast Guard.

1. Does the use of fish oil lower the incidence of depression, post-traumatic stress, or suicide ideation among active duty military service personnel?

2. What is the relationship between demographics, combat exposure, lifestyle—activities, lifestyle—nutrition, and lifestyle—stress and mental health issues?

3. Is there a heterogeneous impact of fish oil use on mental health issues by gender and service in particular, the Navy population?

This thesis is quantitative in nature, and will involve logistic regressions using the 2011 DOD Health Related Behaviors (HRB) Survey of Active Duty Military Personnel. My analysis focuses on three outcomes that capture a service members' mental health state (depression, post-traumatic stress, suicide ideation), and whether service members sought mental health therapy within the past 12 months. I estimated logistic regression models where the key independent variables were various levels of fish oil use (none [reference group], light, moderate, and daily use). For each outcome, I estimated five models that include control variables in the following categories: demographics, combat exposure, lifestyle—activities, lifestyle—nutrition, and lifestyle-stress. In addition, I estimated a model on the Navy-only population to examine whether Navy personnel might exhibit different patterns than DOD as a whole. I also explore whether there is gender differences in the association between fish oil usage and mental health outcomes.

The following chapters of this thesis are organized as follows. Chapter II is the literature review focusing on the following areas: (1) characteristics of PTSD risks; (2) current research concerning the correlation between omega-3 and PTSD, depression,

and suicides; (3) the difference between military diets and civilian diets; and (4) the effects an individual's diet contributes to omega-3 levels in the body. Chapter III will focus on the data and methodology portion. This chapter will include how the four outcome variables and the key independent variable are derived, what control variables are used in which regression models, as well as the logit regression models that are used. Chapter IV will introduce the summary statistics of both the outcome and control variables with respect to fish oil use as well as delve into the results and analyze what information developed when Logit regressions were run. Finally, Chapter V will include concluding thoughts, study limitations, recommendations, as well as where further research should be directed with regard to this topic and this study.

Based on responses in the 2011 DOD HRB survey, the key findings suggest that fish oil use does not lead to lower incidences of depression, Post-Traumatic Stress, or suicide ideation in military service members. When the analysis is limited to Navy-only sample, the results show that light fish oil use lowered the likelihood of Navy personnel experiencing high PTS in the past 30 days, although this finding is not robust to various model specifications.

II. LITERATURE REVIEW

In the past twenty years, researchers have started investigating the relationships between omega-3 and PTSD, depression, and suicide (WebMD–Depression, 2015). In this chapter, I will explain characteristics of personnel most at risk for developing PTSD, synthesize the known research that has previously been completed with regard to omega-3 and its correlation with PTSD, depression and suicide risk, as well as conclude the chapter by describing omega-3 levels, healthy diets and the difference between military and civilian diets.

A. CHARACTERISTICS OF PTSD RISKS

Before delving into the studies regarding the effect of omega-3 on PTSD, we must first identify who is at risk for developing PTSD. PTSD has been identified as reoccurring stressful episodes that occur after an individual has experienced a traumatic event (NIMH, 2015). Many individuals can experience a traumatic event and move on. Those who cannot move past the event and experience reoccurring episodes of anxiety, depression, and insomnia may have PTSD (NIMH, 2015). According to the National Center for PTSD (2013), experiencing a traumatic event in an individual's life is common; in fact, 60 percent of American men will experience a traumatic event, while of those men, only 8 percent will develop PTSD (p. 2). Fifty percent of American women will experience a traumatic event, and of those women, 20 percent will develop PTSD (National Center for PTSD, 2013, p. 2). These traumatic events include natural disasters, sexual assault, combat attack, and serious accidents. Researchers Hibbeln and Gow (2014) identify certain characteristics of military personnel who are at a higher risk for developing PTSD (p. 117). These characteristics include the following: unmarried, female, Hispanic ethnicity, being a member of the reserves or National Guard, lower rank, and lower level of education (p. 117). Additionally, Hibbeln and Gow state that service members who have experienced a traumatic brain injury, witnessed death, undergone prolonged deployments, and endured prolonged combat exposure are more prone to developing PTSD (p. 117). RAND completed a study in 2008 that found that the

rates of PTSD and major depression in the military are most prevalent among the Army and Marine branches as well as troops that were no longer active duty personnel (reserves, retired, or discharged) (p. 2). Though PTSD and depression can affect anyone not just service members, Harvard epidemiologist, Ronald Kessler, has found that the rate among military members for major depression is five times that of their counterpart civilians, while the incidence of PTSD is fifteen times higher in military members than civilians (Ursano et al., 2014).

B. OMEGA-3 AND PTSD

Little research has been conducted on omega-3 and its correlation with PTSD. Daisuke Nishi and his colleagues researched one of the first cases concerning the effects of omega-3 on PTSD using data pertaining to the rescue workers of the 2011 Great East Japan Earthquake (Nishi et al., 2013). This study was a "single-blind, randomized, parallel-group field trial" performed by the National Disaster Medical Center in Tokyo, Japan (Nishi et al., 2013, p. 409). A total of 172 randomized rescue workers participated in the study, which took place over twelve weeks (p. 413). The control group, consisting of 86 workers, was provided psychoeducation alone while the treatment group, 86 workers, was provided psychoeducation plus seven capsules per day of fish oil, each containing 320 mg. of fish oil broken into 70 percent DHA and 7 percent EPA (p. 410). The results of this study did not show that the experimental group taking the fish oil and undergoing psychoeducation had statistically significant lower levels of PTSD in relation to the control group undergoing psychoeducation alone (p. 416). Because both the control and treatment group ultimately had lower levels of PTSD at the end of the experiment, the most vital piece of information to surface was that fish oil helped to reduce PTSD symptoms more in women (p. 418). This study conjured up an interesting point as to why fish oil is more beneficial to women than to men in regard to PTSD and depression. Nishi et al. postulate that the higher DHA concentrations in women than in men could result from increased estrogen in women (p. 418). This study had limitations in that it did not include a double-blind trial that used placebos and it relied on self-reporting and not biomarkers (p. 419). As well, since there were only a small number of patients the sample may not discover small effects that could have resulted in the data.

Nishi worked with other researchers on another case that involved both fish oil and PTSD. Unlike the other study, this study was a nested case-control analysis of the fatty acid serum levels of 300 injured patients from the Tachikawa Cohort of Motor Vehicle Accident Study (Matsuoka, Nishi, & Hamazaki, 2013, p. 408). The results were similar to the previous study in which they found that EPA and DHA levels were higher among women than men but the AA (Arachidonic Acid) levels were not significant between women and men (p. 408). Both DHA and AA are "fatty acids that affect brain functions by altering the biophysical properties of cell membranes" (Hashimoto et al., 2014, p. 294). As well, the researchers found that baseline AA and EPA values were inversely correlated with the risk of developing PTSD after a serious accident (Matsuoka et al., 2013, p. 408). There were limitations in that this study was limited in scope regarding the number of personnel involved in the sample as well as it was single source collection location for the study (p. 408).

Therefore, with the small amount of research regarding omega-3 and PTSD, the data presented shows that omega-3 is beneficial in helping with PTSD, in particular women. The question of main concern among researchers is what values of EPA and DHA in omega-3 reduce the incidence of PTSD among both men and women (Nishi et al., 2012, p. 316)? As well, why are women more prone to a reduction in mental health issues with the introduction of fish oil (Nishi et al., 2012, p. 316)?

C. OMEGA-3 AND DEPRESSION

According to the Anxiety and Depression Association of America, 14.8 million American adults are affected every year by the condition, Major Depressive disorder (2014). The *Journal of Affective Disorders* was among the first to note omega-3's impact on depression in 1998 (WebMD–Depression, 2015). Fourteen years later, Bloch and Hannestad (2012) studied 731 individuals in thirteen randomized and placebo-controlled trials to look at the effects of omega-3 on major depressive disorder (p. 1272). They found that after removing publication bias there was no evidence that omega-3 helped to alleviate major depressive disorder (p. 1272). Their findings are different from the literature of Martins et al., which agree that omega-3 with an EPA value greater than

60 percent is effective for lessening depression (Martins, Bentsen, & Puri, 2012, p. 1147). Bloch and Hannestad realize their data identifies results contradictory to other researchers, but they feel that by removing the publication bias through the trim-and-fill method, and researching omega-3 effects only on major depressive disorder, their results are more accurate than those of other researchers (Bloch & Hannestad, 2012, p. 1277). They explain that other researchers who have identified the positive effects of omega-3 on depression may initially have set out to study the effects of omega-3 on other psychiatric conditions, such as schizophrenia, and because that condition may have slightly lessened, the secondary condition, depression, may have dramatically lessened (p. 1277). Bloch and Hannestad found no effects of omega-3 helping a patient who was only diagnosed with major depressive disorder (p. 1277). They do acknowledge that their study has flaws in that they used study-level data as oppose to patient-level data that would have been more accurate in evaluating the treatment effect (p. 1278).

Martins et al. (2012) discredit the findings of Bloch and Hannestad. Their argument is that Bloch and Hannestad claim to have studied only individuals with major depressive disorder, but they used a study from Rogers et al. (2008) in their meta-analysis that clearly states that the individuals in the study had mild to moderate depression with no formal diagnosis (p. 1144). Martins et al. found errors with the inclusions, exclusions, study subgroup, and the outcome measures used by Bloch and Hannestad (2012, p. 1144). Martins et al. reanalyzed Bloch and Hannestad's data through sensitivity analysis by excluding Rogers et al. (2008) and other subgroups (2012, p. 1146). They also conducted the study to analyze different percentages of EPA values in the omega-3 supplements (2012, p. 1146). They divided the EPA analysis into greater than or equal to 60 percent and less than 60 percent (2012, p. 1146). In conclusion, Martins et al. found that major depressive disorder is correlated with EPA levels in omega-3 and in particular has the highest correlation among EPA levels greater than or equal to 60 percent (2012, p. 1144).

D. OMEGA-3 AND SUICIDES

Research has focused much time and effort on omega-3 and its positive correlation with lower suicide rates. In 2011, Dr. Michael Lewis and his colleagues conducted a study comparing the total fatty acid serum of 800 active duty military members who had committed suicide within the timeframe 2002–2008, to a control group (p. 1585). The military members who had committed suicide were compared to the control group across sex, rank, and year of incident (p. 1585). Not only was the incidence of suicide in the test group used, but the researchers also looked at the military members' post-deployment health surveys to find out when and where they had been deployed (Lewis et al., 2011, p. 1585). The ICD-9 mental health diagnosis and substance abuse diagnosis reports were obtained as well (Lewis et al., 2011, p. 1585). The results indicated there was a 14 percent greater risk of suicide with each standard deviation drop of DHA percentage (Lewis et al., 2011, p. 1588). Additionally, the risk of suicide in men was 62 percent higher among those with lower DHA levels (Lewis et al., 2011, p. 1588). Not only was the risk of suicide greater in men with lower levels of DHA, but suicide risk was 54 percent higher in those personnel who had experienced death and seen wounded personnel (Lewis et al., 2011, p. 1589). The DHA levels were the most telling, as this is the fatty acid that is concentrated in the brain and helps with neurological function (Lewis et al., 2011, 1586). One of the researchers of the study, Dr. Hibbeln, claimed that because of extremely low DHA levels, the risk of suicide by a service member could be increased by 75 percent (Miles, 2012, p. 1). This study concluded that low DHA levels prove to be a risk factor for higher rates of suicides by active-duty military personnel (Lewis et al., 2011, p. 1589).

In contrast to the study completed by Lewis et al., Tsai et al. (2014) conducted a cohort study that collected data from 205,357 U.S. men and women over a 14–22 year period (p. 1458). They performed omega-3 and omega-6 assessments every four years through a "food frequency questionnaire" (Tsai et al., 2014, p. 1459). The study used pooled data across the cohorts using a "random-effects meta-analysis" as well as "estimated with multivariable Cox proportional hazards models" to estimate the risk of completed suicide (Tsai et al., 2014, p. 1458). The findings of their study showed no

evidence that fish oil decreased completed suicide risk (Tsai et al., 2014, p. 1458). There were limitations to their study, in that they focused only on individuals over the age of 29 (Tsai et al., 2014, p. 1464). Since earlier years are more prominent in brain growth, the researchers acknowledge that fish oil could have provided a "sizeable protective effect" in younger individuals (Tsai et al., 2014, p. 1464). With most mental health issues having a median onset age of early to mid-twenties, Tsai et al. may have missed the ability to collect more data by not expanding the trial age group (Tsai et al., 2014, p. 1464). As well, another limitation to their study was the lower levels of EPA + DHA fish oil they used in the study (Tsai et al., 2014, p. 1464). The highest percentage they used was .82 g/day while most other studies have used the recommended dosage of 1 g/day of EPA + DHA fish oil to treat depression (Tsai et al., 2014, p. 1464).

E. OMEGA-3, DIET, AND MILITARY MEMBERS VERSUS CIVILIANS

In 2010, Harvard researchers calculated 72,000–96,000 yearly preventable American deaths resulted from omega-3 deficiency (Starling, 2010, p. 1). With a diet that relies heavily on grains and processed food, and which places low emphasis on fatty cold-water fish, Americans commonly are omega-3 deficient. Most Americans can supplement their diets with an omega-3 supplement, provided that the supplement contains the correct ratio of EPA and DHA. Military members are even more disadvantaged when it comes to omega-3 sufficiency. Most service members' diets have a high omega-6 to omega-3 ratio. With the chow halls and MREs providing more processed and refined foods than fatty cold water fish and grass-fed meats, military members are not able to maintain a correct balance of omega-6 to omega-3 in their diet in order to promote healthy brain function. The correct ratio of omega-3 to omega-6 in an individuals' body is 8–10 percent of omega-3 as a proportion of total fatty acids in the blood (Coulter, 2014, p. 195). Discussion with an expert panel from the Nutritional Armor for the Warfighter Conference found that on average American military members have less than 2 percent of omega-3 as a proportion of total fatty acids in their blood (Coulter, 2014, p. 195).

In order for service members to increase their omega-3 levels to promote healthy neuronal functioning, diets need to be upgraded or omega-3 supplements such as fish oil need to be provided to military members. If the choice is to upgrade military diets, then dining facilities and MREs provided to service members need to incorporate more cold-water fatty fish, grass-fed meats, poultry, eggs, and less-refined grains and omega-6 fats (Coulter, 2014, p. 193). Another source that could be cost-effective is to require the military to take omega-3 supplements (Coulter, 2014, p. 193). These over-the-counter omega-3 supplements are low cost and easy for military members to acquire. Caution does need to be expended when augmenting omega-3 levels in the body with supplements instead of diet, as personnel need to focus on the EPA and DHA doses in these fish oil supplements (Freuman, 2014). According to data collected from numerous researchers in the field by McNamara and Strawn (2014), an acceptable dose of omega-3 for pediatric, adolescent, and adult psychiatric patients is 1–4 g/d of EPA and DHA in a two-to-one ratio (p. 48). The above dosage has been shown to help with mood disorders, but a higher dosage may be needed to help with depressive symptoms (McNamara and Strawn, 2014, p. 48).

Other recommendations made by doctors in the fight for omega-3 levels to be increased in our military is to increase the number of nutrition programs on military bases where a discussion is focused on omega-3 and its health benefits (Coulter, 2014, p. 193). Annual military medical exams could include a blood test for omega-3 levels so military members understand where they are in retrospect of the optimal omega-3 levels (Coulter, 2014, p. 193). Another recommendation is to conduct training for military members to incorporate fish oil use into their daily diet (Coulter, 2014, p. 193). The last recommendation made by these experts is to require SEALS and other highly specialized military members to take fish oil in order to encourage other military members to follow suit (Coulter, 2014, p. 193).

In 2012, a study by the Pennington Biomedical Research Center was initiated in which a randomized study created a treatment group that received military dining foods such as chicken, eggs, beef, and oil highly fortified with omega-3, while the control group received the normal food without the fortified omega-3 (Champagne, 2012). The

study, which is still currently ongoing with a completion date of 2020, consists of 72 men and women from age 18–40 completing a ten week / seven day repetitive diet in military dining facilities from one of three treatment options—regular diet, medium omega-3 diet, high omega-3 diet—to see if omega-3 blood levels in military members can naturally be increased by diet alone and if higher omega-3 levels in individuals leads to improved cognitive response, satiety, and fitness levels (Champagne, 2012).

F. SUMMARY

For every article published saying omega-3 is protective and beneficial against PTSD, depression, or suicides, there is another article discrediting the research. This topic is difficult to evaluate and reach a definitive conclusion as there are numerous ways to attack and analyze the research. Mischoulon (2011) points out that many contradictory results can be obtained based on the percentage of EPA to DHA in the omega-3 (p. 1574). As well, each study uses different daily dosages of fish oil to evaluate if major depressive disorder, PTSD, or suicides are lessened (Mischoulon, 2011, p. 1574). Finally, Mischoulon points out that the studies presented so far vary immensely in the measurement of the outcome variables (p. 1575). Some outcome variables—depression and PTSD levels—can lend themselves to bias by the individual; other outcomes—suicide deaths—are much more restrictive in their interpretation (Mischoulon, 2011, p. 1575).

The literature review shows many papers documenting a correlation between omega-3 and depression and suicides. There has been minimal emphasis on researching the correlation between omega-3 and PTSD, and the small amount of current research that has been completed on the correlation between omega-3 and PTSD has been with civilians. The goal of my thesis is to take a military-only survey that canvases all five branches of active duty personnel and analyzes the association between fish oil use levels and the following mental health measures: depression, post-traumatic stress, suicide ideation, and mental health therapy. The multivariate model will control for other potential correlates in categories of demographics, combat exposure, and lifestyle (broken down to three dimensions: activities, nutrition, and stress).

III. DATA AND METHODOLOGY

This chapter's primary focus is to describe the data used in my regression models as well as the construction of the outcome and key independent variables. I begin by explaining the data set and the sample population that was surveyed. I then expand on the creation of the key variables used in the research and finish with an explanation of the methodology used analysis.

A. DATA

The data for my thesis is from the 2011 Department of Defense (DOD) Health Related Behaviors Survey of Active Duty Military Personnel. Sponsors of the survey included the Department of Defense, TRICARE Management Activity (TMA), Defense Health Cost Assessment and Program Evaluation, and the United States Coast Guard. ICF International conducted the survey under the direction of the Office of the Assistant Secretary of Defense for Health Affairs, TMA, and the United States Coast Guard. The DOD Health Related Behaviors survey was conducted from August 2011 to January 2012. Even though the anonymous survey was in its eleventh edition, 2011 was the first year the survey was issued online. By issuing the survey through the Web, administrators did not need to geographically cluster the responses as the responses were now collected from military members throughout numerous locations and not particular military installations. The survey included 168 questions emphasizing "the following categories: sociodemographic characteristics, healthy lifestyle and disease prevention, substance use (alcohol use, illicit and prescription drug use and misuse, tobacco use, culture of substance use), stress and mental health, deployment and combat exposure, and service commitment" (DOD 2011 Health Related Behaviors Survey, 2011, p. A-1). The 2011 survey was the first year particular questions pertaining to vitamins, supplements, and strength training were used.

B. SAMPLE POPULATION

During the time of administration, the survey was sent to 154,011 currently non-deployed, active duty military members from the following four branches of the

Department of Defense: Army, Navy, Marine Corps, and Air Force. The survey was also sent to 14,653 active duty military members from the Coast Guard. The response rate was 22 percent for the DOD with 34,416 responses and 37 percent for the Coast Guard with 5,461 responses. Since the survey was considered a "stratified random sample" due to its web-based administration, the DOD active duty personnel were now categorized by service, gender, and paygrade while the Coast Guard active duty personnel were categorized by work setting (ashore, afloat, air), gender, and paygrade.

The administrators applied two survey weight values to account for the probability of over and under sampling from any particular demographic. The final population survey weight reweights the respondents so that the results are representative of the military population as a whole, while the final sample survey weight reweights the sample so that the results are representative for each individual service. In my thesis, I apply the population weight to analysis involving all branches of services so the estimated results are representative of the DOD as a whole. I apply the sample weight to analysis involving the Navy population only, so that the coefficients are representative of the Navy.

C. KEY VARIABLES

Since my thesis is studying the correlation between fish oil use and mental health, I constructed the following outcome and independent variables to use in the analysis. Below I explain the four outcome variables—depression, post-traumatic stress, suicide ideation, and mental health therapy—as well as the key independent variables—different levels of fish oil. Furthermore, I explain the control variables divided into the following five categories: demographics, combat exposure, lifestyle-activities, lifestyle-nutrition, and lifestyle-stress. Since I run regression models on four outcome variables, I looked at outcomes that are both mental health issues as well as therapy treatments for mental health issues. The first three variables correspond to mental health issues a service member can experience—depression, post-traumatic stress, and suicide ideation—while the last variable—mental health therapy—corresponds to the therapy treatment sought by a service member in the past 12 months preceding the survey time.

1. Outcome Variables

This thesis used the following four variables as the outcome variables.

a. Depression

The variable "depress" captures the incidence of depression in the past week. The variable was constructed by ICF using responses from two questions. Individuals were asked the following: "On how many days in the past week did you feel depressed for most of the day?" and "On how many days in the past week did you feel sad for most of the day?" (DOD 2011 Health Related Behaviors Survey, 2011, pp. 201–202). The survey administrators generated values for each of the five responses where the lowest response of "never" was assigned a value of zero and the highest response of "5–7 days" was assigned a value of one[1]. Once values from these two questions were averaged, the depress variable was labeled "high depress" for a score of 0.75 or greater and "low depress" for a score of greater than zero but less than 0.75. The depress variable was then recoded by the survey administrators to a binary variable where depress equals zero for low incidence of depression and depress equals one for high depression incidence.

b. PTS

The variable "PTS" records the incidence of post-traumatic stress in the past 30 days. The survey writers created this variable by ranking the responses to four questions on a five-point scale with the lowest response being "not at all" and the highest being "extremely." The four questions focused on whether participants were affected in the following ways in the past 30 days: "feeling very upset when something reminded you of a stressful experience," "feeling emotionally numb or being unable to have loving feelings for those close to you," "having difficulty concentrating," and "feeling jumpy or easily startled" (DOD 2011 Health Related Behaviors Survey, 2011, pp. 207–209). The survey creators calculated the average of the responses to these four questions, and an average of less than four was labeled "low PTS" while an average of four or greater was

[1] The following five choices for each of the two questions were: "5–7 days, 3–4 days, 1–2 days, less than 1 day, and never" (DOD 2011 Health Related Behaviors Survey, 2011, p. 380).

labeled “high PTS.” The survey administrators recoded the PTS variable to a binary variable where PTS equals zero for low PTS and equals one for high PTS. Notably, the PTS variable only determines if the service member has a reason to be referred to a medical professional for post-traumatic stress but does not diagnose the individual with post-traumatic stress; therefore, the variable cannot be called PTSD because no diagnosis has occurred.

c. Suicide Ideation

The suicide ideation variable results from the data collected on the following question: “If you have seriously considered suicide, did you consider it during the following periods?—within the past year” (DOD 2011 Health Related Behaviors Survey, 2011, p. 217). The values in the original survey were equal to one for the answer “no” and two for the answer “yes.” The response to this question is conditional on answering the question before in the affirmative “Have you ever seriously considered suicide?” (DOD 2011 Health Related Behaviors Survey, 2011, p. 216). Individuals who answered the latter question in the negative were assigned a logical skip for the question related to suicide ideation in the past year. I recoded the suicide ideation variable to a binary variable where incidence of suicide ideation in the past year takes on the value one and non-suicide ideation in the past year takes on the value zero including individuals who have never had any suicide ideation.

d. Mental Health Therapy

I created the variable mental health therapy from the following two survey questions: “In the past 12 months, did you receive counseling or mental health therapy/treatment from a mental health professional at military facility?” and “In the past 12 months, did you receive counseling or mental health therapy/treatment from a civilian mental health professional?” (DOD 2011 Health Related Behaviors Survey, 2011, pp. 209–211). The mental health therapy variable takes on the value 1 if respondent answers yes to either of the two questions and 0 otherwise.

2. Key Independent Variable

From the survey question asking about fish oil use in the past 12 months, I constructed a measure of different levels of fish oil use. The following were the survey responses to the question: “two or more times a day,” “once a day,” “every other day,” “once a week,” “once a month,” and “never in past year” (DOD 2011 Health Related Behaviors Survey, 2011, p. 38). Respondents were categorized to the following fish oil consumption categories: *none* if the response to fish oil question was “never in past year”, *light* if the response was “once a month”, *moderate* if the response was “once a week” or “every other day,” and *daily* if the responses was “once a day” or “two or more times a day” (DOD 2011 Health Related Behaviors Survey, 2011, p. 38).

For each outcome, these fish oil consumption levels are always included in all models. Because fish oil consumption are also likely to be correlated with other demographic and life style characteristics, I estimate 5 models with each of the following categories of control variables added in sequentially.

3. Demographic and Service Variables

The first model I ran included only the demographic control variables. The following are the demographic variables used in my logit regressions: service, unit type, pay group, gender, time on active duty, education, race, age, and family status. The service variables represent the branch of service the survey taker is currently serving in: Army, Navy, Marine Corps, Air Force, and Coast Guard where Army is the reference group for the population weighted regressions. The unit type variables are Combat Arms which represents infantry, armored/tank, artillery/naval gun crew, combat engineer, aircraft aircrew, aircraft/missile command and control, and security/military police. The second unit type variable is Combat Service Support which represents any logistics units, maintenance or repair divisions, and food preparation and food service. Combat Support, the third unit type variable, represents reconnaissance, surveillance, or target acquisition units as well as communications, signals or military intelligence units. The Headquarters and MPTE unit variable pertains to any headquarters, command, or administrative unit as well as recruitment and training/education units. The other two variables under unit type

are Medical and Other where, medical includes medical, dental, and other healthcare and Other includes any other type of unit not listed as well as the survey participants who declined to answer. I chose to have Combat Arms be the reference group.

The variables for pay group are junior enlisted which include the ranks E1-E4 and junior officer which include the ranks officer trainee/warrant officers/ and O1-O3. The variable, senior enlisted, includes the ranks E5-E9, while senior officer includes the ranks O4 and above. I chose junior enlisted as the reference group. The control variables for time on active duty are less than year active duty, short active duty of 1–3 years, medium active duty of 4–9 years, and long active duty of 10+ years. The variable less than a year active duty was used as the reference group.

Among the demographic factors, I include an indicator for female. To control for differences in education, I constructed indicator variables for high school, some college, and college graduate or above with high school graduates serving as the reference group. The survey divided race into four categories: White, non-Hispanic, African-American, non-Hispanic, Hispanic, and other. I used White as the reference group for race. I included the following age categories: 18–25 (reference group), 26–35, 36–45, and 46–65. For the final demographic variable, family status, a binary variable was used where the variable takes a value one if the service member is married, no matter if the spouse is present or not, and a zero if the service member is unmarried.

4. Combat Exposure Variables

I added the category of combat exposure control variables to my second regression model. I used two control variables to explain combat exposure in my regressions—combat exposure level and deploy in the past year variable. The combat exposure level was a variable that was generated by the survey administrators through the answers on 17 survey questions pertaining to combat related questions such as “I personally fired my weapon at the enemy,” “my unit suffered causalities,” and “I was wounded in combat” (DOD 2011 Health Related Behaviors Survey, 2011, p. 386). The survey administrators created the following responses to the combat level variable of “no combat,” “low exposure,” “moderate exposure,” and “high exposure.” I combined

"moderate" and "high" into one variable. The reference group for this question was no combat exposure. The second variable is deploy in the past year. I generated this variable as a binary variable where the variable takes on the value one if either of the two questions—"combat deployed in the past year" and "non-combat deployed in the past year," generated by the survey administers is answered as "yes" (DOD 2011 Health Related Behaviors Survey, 2011, pp. 384–385).

5. Lifestyle—Activities Variables

The next three models further explores how association between the mental health outcomes and fish oil consumptions might vary when I added three dimensions of life style: physical activities, nutrition, and stress. In the third model I include additional controls to capture physical activities. The first variable I used for lifestyle-activities was the BMI variable that the survey administrators created. The following dummy variables for BMI are: underweight, healthy weight, and overweight. The overweight variable combined the choices of overweight and obese in the survey. I used healthy weight as my reference group. One of the questions incorporated into the category of lifestyle-activities control variables was the frequency of strength training per week that was created by the survey administrators. The response to this question were "less than one day per week," "1–2 days per week" and "3 or more days per week" (DOD 2011 Health Related Behaviors Survey, 2011, p. 355). My reference group was less than one day a week, and I created two indicators for normal (1–2 days per week) and high (3 or more days) strength training. I generated two variables, "underactive" and "overactive," from the survey questions pertaining to moderate and vigorous activity. I created the variable "underactive" where moderate activity and vigorous activity equal less than 150 minutes per week and less than 75 minutes per week respectively. The variable "overactive" was created where moderate and vigorous activity equal 300 minutes or more per week and 150 minutes or more per week respectively.

6. Lifestyle—Nutrition Variables

I also created controls for lifestyle factors such as nutrition differences across individuals. The nutrition variables included sugar intake, fried food intake, caffeine

intake, and daily supplement use. I created the high sugar intake variable by combining the two questions the survey administrators asked about the frequency of consumption of sweets and sugary drinks in a typical week. Any response to either of these questions that was “three or more times per day,” “two times per day,” “one time per day,” or “three to six times per week” was counted as high sugar intake (DOD 2011 Health Related Behaviors Survey, 2011, p. 33). The second variable I created was high caffeine intake. This variable was calculated the same where any of the responses above applied to the question about the amount of caffeinated drinks consumed in a typical week. The third variable I created was high fried intake which corresponded to the above values based on consumption of fried foods in a typical week. The last variable did not look at food sources but rather supplement use. This variable, daily supplement intake, was created if the survey participants answered “once a day” or “two or more times a day” to any of the supplement questions asking about supplement use of: “multiple vitamins and minerals, individual vitamins or minerals, antioxidants, legal body-building supplements, herbal supplements, weight loss products in the past twelve months” (DOD 2011 Health Related Behaviors Survey, 2011, pp. C-11–C-12).

7. Lifestyle—Stress Variables

In order to explore whether the association between fish oil consumption and mental health outcomes might be driven by the possibility that hypochondriac people are systematically more likely to consume fish oil, I add a fifth model that capture people who have the propensity to be in high stress *and* high anxiety state (the survey does not have specific questions that allow me to capture people who might be hypochondriacs). The survey administrators asked two questions to measure general stress level and four questions to measure anxiety level (DOD 2011 Health Related Behaviors Survey, 2011, pp. 379–380). From these questions, the administrators created a “high overall stress level in the past 12 months” variable that had measurement levels of high and low and a “high anxiety level in the past 30 days” variable that had measurement levels of high and low (DOD 2011 Health Related Behaviors Survey, 2011, p. 319). I created variables called high stress and high anxiety that are each equal to the returned values of high incidence for the respective stress and anxiety variables created by the administers.

8. Missing Indicators

The survey administrators labeled any blank and missing answers as (-9999) and (-3333) and any logic skip to questions as (-8888). I created missing indicators for any of these values. Then, I recoded the missing values and logic skips as zero for the key control variables. For the key independent variable capturing the levels of fish oil use and the outcome variables, I did not code the missing answers as zeros leaving them missing. This ensures the relationship between fish oil and mental health outcomes is not confounded with measurement error in the construction of these key variables.

D. METHODS

Using a quantitative approach, I estimated logit regressions for the four outcome variables—depression, post-traumatic stress, suicide ideation, and mental health therapy—with respect to my key independent variable of fish oil use levels. For each of the four outcome variables, I estimated five models. Model One looked at controls for the demographics of the individual. Model Two includes demographics and the combat exposure variables. Model Three added the lifestyle-activities category to the list of control variables, Model Four included an additional set of control variables called the lifestyle-nutrition category, and Model Five, the most comprehensive model, added high stress and high anxiety control variables. Since the data collected was in survey form and the administrators applied two survey weight values to the data, I used the final population survey weight for all five of the above models with the four outcome variables so that I could draw conclusions across all five branches of service.

Using model 5 as the base, I conduct two additional analysis on all 4 outcomes. The first subset of Model Five explores whether the results might differ by gender. In particular, I add an interaction variable between female personnel and my key independent variable of fish oil use.

The second additional analysis based on Model Five focus on Navy only. Given that sailors spend substantial amount of time at the sea, they might exhibit different results than the other services. In only looking at the Navy personnel, I applied the final sample survey weight as this analyzes the data with respect to only the Navy sample size.

I chose the above models and control variables as I feel they will best analyze my research questions. Since my research question analyzes the correlation between the use of fish oil levels with respect to mental health issues, the control variables of combat exposure, having been deployed in the past year, and supplement and nutritional use, are important to analyze. Though my models include an extensive amount of control variables, like any observational studies, it is still impossible to control for 100 percent for the potential bias that could result, and therefore the relationship between fish oil use and mental health cannot be classified as a causal relationship due to the possibility of omitted variable bias.

The next chapter will display the summary statistics for each of the outcome and control variables. As well, I will present and discuss the key findings from the logit regression models I conducted.

IV. RESULTS

This chapter will provide an analysis of the results from my logit regressions conducted on the five models explained in Chapter III. I will begin by discussing the weighted descriptive statistics for all five services. Next, I will present my logit regression results with regard to depression, PTS, suicide ideation, and mental health therapy outcome variables. Finally, I will discuss my results with regard to my fish oil-female interaction variables as well as the analysis on the Navy sample.

A. DESCRIPTIVE STATISTICS

Column one of Table 1 represents the population of the entire survey sample—39,877 military personnel. From left to right, columns two through five display the percentage of each control variable as the key independent variable—fish oil use—is added in incremental levels. For example, junior enlisted represent 44 percent of the whole sample, but conditional on light fish oil use, junior enlisted represent 51 percent of the sample. When the sample is restricted to daily fish oil use, then junior enlisted represent only 39 percent of the sample. Notably, military personnel who performed high levels of strength training, which is identified as three or more days per week, represent 44 percent of the whole sample. When the sample is restricted to daily fish oil users, then the percentage of military personnel who performed high levels of strength training is 58 percent.

Table 1. Descriptive Statistics for Control Variables

VARIABLES	Whole Sample	Sample when Fish Oil Use == None	Sample when Fish Oil Use == Light	Sample when Fish Oil Use == Moderate	Sample when Fish Oil Use == Daily
Demographics and Service					
Army	36%	37%	33%	32%	37%
Navy	23%	22%	24%	26%	23%
Marine Corps	14%	13%	18%	16%	14%
Air Force	24%	25%	22%	23%	23%
Coast Guard	3%	3%	3%	3%	3%
Combat Arms	20%	20%	19%	21%	21%
Combat Service Support	30%	30%	34%	32%	28%

VARIABLES	Whole Sample	Sample when Fish Oil Use == None	Sample when Fish Oil Use == Light	Sample when Fish Oil Use == Moderate	Sample when Fish Oil Use == Daily
Combat Support	11%	11%	9%	10%	11%
Headquarters and MPTE	17%	17%	17%	16%	18%
Medical	11%	11%	11%	10%	11%
Other	10%	10%	10%	10%	11%
Junior Enlisted	44%	44%	51%	44%	39%
Junior Officer	11%	11%	9%	12%	11%
Senior Enlisted	39%	39%	35%	38%	42%
Senior Officer	6%	6%	6%	6%	9%
Male	85%	84%	86%	88%	87%
Female	15%	16%	14%	12%	13%
Short Active Duty 1–3 years	31%	31%	36%	32%	27%
Long Active Duty 10+ years	34%	34%	29%	33%	40%
Medium Active Duty 4–9 years	27%	27%	26%	28%	27%
Less than Year Active Duty	8%	8%	10%	7%	6%
High School or Less	23%	24%	26%	22%	18%
Some College	51%	51%	50%	49%	52%
College Graduate or Above	26%	25%	24%	30%	30%
White	66%	67%	60%	63%	66%
Black	13%	13%	15%	14%	13%
Hispanic	13%	13%	16%	14%	13%
Other Race	6%	6%	8%	8%	7%
18–25	30%	31%	35%	31%	25%
26–35	35%	35%	35%	35%	35%
36–45	20%	20%	16%	19%	22%
46–65	4%	4%	3%	3%	7%
Family Status	63%	64%	60%	61%	64%
Lifestyle–Activities					
Under Weight	1%	1%	0%	0%	0%
Healthy Weight	32%	34%	32%	30%	26%
Over Weight	57%	55%	56%	58%	63%
Low Strength Training	26%	29%	23%	21%	17%
Normal Strength Training	27%	28%	30%	26%	21%
High Strength Training	44%	39%	44%	49%	58%
Under Active	26%	27%	25%	26%	20%
Over Active	17%	15%	17%	18%	23%
Lifestyle–Nutrition					
High Sugar Intake	66%	68%	66%	66%	57%
High Fried Intake	34%	35%	35%	35%	27%
High Caffeine Intake	67%	67%	65%	70%	69%
Daily Supplement Intake	52%	41%	45%	52%	93%
Lifestyle–Combat Exposure					
None Combat Level	57%	57%	62%	59%	53%
Low Combat Level	10%	10%	10%	10%	9%
High Combat Level	33%	33%	29%	31%	38%
Deployed in the Past Year	23%	23%	22%	24%	24%

VARIABLES	Whole Sample	Sample when Fish Oil Use == None	Sample when Fish Oil Use == Light	Sample when Fish Oil Use == Moderate	Sample when Fish Oil Use == Daily
Lifestyle–Stress					
High Stress	34%	34%	31%	33%	34%
High Anxiety	13%	13%	14%	12%	14%
Observations	39,877	26,765	2,329	3,123	7,162

+Values in table are weighted using the final population survey weight

Based on Table 1 descriptive statistics for the whole sample, the percentage breakdown among the service members who completed the survey is 36 percent Army, 23 percent Navy, 14 percent Marine Corps, 24 percent Air Force, and 3 percent Coast Guard. Chapter III identified the survey response rate as 22 percent (34,416 responses) for DOD and 37 percent (5461 responses) for Coast Guard. The majority of the respondents were junior and senior enlisted who comprised 44 percent and 39 percent of the sample, respectively. In addition, a typical military member who completed the survey was a White male between the ages of 26–35 who had completed some college. The most prominent unit type represented in the survey was Combat Service Support with 30 percent of the responses. These personnel work in the following fields: logistics units, maintenance or repair divisions, and food preparation and food service.

When it came to combat exposure control variables, 57 percent of the survey respondents had experienced no combat exposure while 33 percent experienced high combat exposure. Only 23 percent of the survey members had been deployed in the past year, whether that be combat deployments or non-combat deployments.

There appear to be some systematic differences in life style factors by fish oil consumption levels. With regard to lifestyle activities and nutrition, of the personnel who answered the health questions, 57 percent were overweight in the whole sample (and the share goes up to 63 percent among those who take fish oil daily) and 26 percent were considered underactive in the whole sample (compared to 20 percent among those who take fish oil daily). A high percentage of the service members consumed both high levels of sugar and high levels of caffeinated drinks, where high levels equate to consumption at

a minimum of three to six times per week. These percentages were 66 percent and 67 percent, respectively (compared to 57 percent and 69 percent among those who consume daily fish oil). Furthermore, with regard to high fried food intake, 34 percent of the whole sample admitted to consuming high levels of fried food, but when the sample was limited to daily fish oil users, the percentage of high-level fried food participants dropped to 27 percent of the sample. Notably, 52 percent of the military personnel who answered the supplement questions said they took a daily supplement of any of the following: "multiple vitamins and minerals, individual vitamins or minerals, antioxidants, legal body-building supplements, herbal supplements, or weight loss products" (DOD 2011 Health Related Behaviors Survey, 2011, pp. 35–37). Furthermore, of those personnel who said they consumed a daily supplement, 93 percent said they also consumed daily fish oil. Finally, 34 percent of the survey takers estimated that they have high levels of stress and 13 percent of the survey takers said they have high levels of anxiety. There did not appear to be drastic systematic differences in share of people reporting high stress or high anxiety across the four fish oil consumption levels.

Table 2 displays the summary statistics for the outcome variables of depression, PTS, suicide ideation, and mental health therapy. These statistics show that 10 percent of the whole sample experienced high depressive symptoms over the past week, 5 percent experienced high PTS symptoms in the past 30 days, 4 percent experienced suicide ideation in the past year, and 17 percent sought therapy for mental health issues in the past year. Of note, the percentage who admitted to mental health therapy decreases when you restrict the sample to personnel who consumed light and moderate fish oil but then increases when you restrict the sample to those who consumed daily fish oil. Furthermore, the percentage of service members who admitted to high PTS when they consumed moderate fish oil was lowest in comparison to any other fish oil consumption level. In general, Table 2 did not show large differences in the outcome variables across fish oil consumption levels.

Table 2. Descriptive Statistics for Outcome Variables

VARIABLES	Whole Sample	Sample when Fish Oil Use == None	Sample when Fish Oil Use == Light	Sample when Fish Oil Use == Moderate	Sample when Fish Oil Use == Daily
Depression	10%	10%	9%	9%	10%
PTS	5%	5%	5%	4%	6%
Suicide Ideation	4%	4%	3%	4%	4%
Mental Health Therapy	17%	17%	16%	16%	20%
Observations	31,180	21,060	1,782	2,395	5,614

+Values in table are weighted using the final population survey weight

B. MULTIVARIATE RESULTS

Table 3 presents the results of the logit regressions for the depression outcome variable across all five models. When looking at light, moderate, and daily fish oil consumption across each of the five models, a majority of the results show that fish oil use is statistically insignificant and therefore, that using fish oil and not using fish oil generate the same odds in the incidence of high depression in the past week. Model Three is the only model that finds a significant coefficient on daily fish oil use. This model, which includes demographics, combat exposure, and lifestyle-activities control variables, shows that personnel who consumed daily fish oil were 1.15 times more likely to experience incidences of high depression in the past week than those who did not consume fish oil. The higher odds can potentially indicate a reverse causality, in that people with depressive symptoms might be advised to take fish oil. However, that association goes away once we control for additional lifestyle factors.

Table 3. Depression Regression Table

VARIABLES Reported as Odds ratio [SE]	MODEL (1) Demographics	MODEL (2) Demographics Combat Exposure	MODEL (3) Demographics Combat Exposure Lifestyle–Activities	MODEL (4) Demographics Combat Exposure Lifestyle–Activities Lifestyle–Nutrition	MODEL (5) Demographics Combat Exposure Lifestyle–Activities Lifestyle–Nutrition Lifestyle–Stress
Light Fish Oil Use	0.95	0.95	0.97	0.97	0.97
	[0.12]	[0.12]	[0.12]	[0.12]	[0.14]
Moderate Fish Oil Use	0.90	0.90	0.93	0.93	0.92
	[0.10]	[0.10]	[0.11]	[0.11]	[0.13]
Daily Fish Oil Use	1.09	1.09	1.15*	1.11	1.05
	[0.09]	[0.09]	[0.09]	[0.10]	[0.10]
Navy	0.78***	0.83**	0.77***	0.77***	0.80**
	[0.06]	[0.07]	[0.07]	[0.07]	[0.08]
Marine Corps	1.00	1.03	1.01	1.01	0.92
	[0.08]	[0.09]	[0.09]	[0.09]	[0.09]
Air Force	0.39***	0.42***	0.42***	0.42***	0.62***
	[0.03]	[0.03]	[0.03]	[0.03]	[0.05]
Coast Guard	0.42***	0.47***	0.44***	0.44***	0.58***
	[0.04]	[0.05]	[0.05]	[0.05]	[0.07]
Combat Service Support	0.88	0.91	0.88	0.87	0.93
	[0.08]	[0.08]	[0.08]	[0.08]	[0.09]
Combat Support	0.71***	0.73***	0.73***	0.73***	0.73**
	[0.08]	[0.09]	[0.09]	[0.09]	[0.10]
Headquarters and MPTE	0.85	0.88	0.88	0.88	0.96
	[0.09]	[0.09]	[0.09]	[0.09]	[0.11]
Medical	1.02	1.06	1.04	1.04	1.12
	[0.12]	[0.13]	[0.13]	[0.13]	[0.15]

VARIABLES Reported as Odds ratio [SE]	MODEL (1) Demographics	MODEL (2) Demographics Combat Exposure	MODEL (3) Demographics Combat Exposure Lifestyle– Activities	MODEL (4) Demographics Combat Exposure Lifestyle– Activities Lifestyle– Nutrition	MODEL (5) Demographics Combat Exposure Lifestyle– Activities Lifestyle– Nutrition Lifestyle– Stress
Other	0.72***	0.74**	0.74**	0.74**	0.80
	[0.09]	[0.09]	[0.09]	[0.09]	[0.11]
Junior Officer	0.34***	0.34***	0.35***	0.34***	0.39***
	[0.05]	[0.05]	[0.05]	[0.05]	[0.07]
Senior Enlisted	0.74***	0.72***	0.75***	0.74***	0.74**
	[0.08]	[0.08]	[0.08]	[0.08]	[0.09]
Senior Officer	0.47***	0.45***	0.47***	0.46***	0.58***
	[0.08]	[0.08]	[0.08]	[0.08]	[0.11]
Female	1.47***	1.50***	1.50***	1.52***	1.00
	[0.09]	[0.09]	[0.09]	[0.10]	[0.07]
Short Active Duty 1–3 years	1.32*	1.28	1.24	1.24	1.02
	[0.20]	[0.19]	[0.19]	[0.19]	[0.18]
Long Active Duty 10+ years	1.50**	1.39*	1.30	1.30	1.05
	[0.26]	[0.24]	[0.23]	[0.23]	[0.21]
Medium Active Duty 4–9 years	1.64***	1.52***	1.43**	1.42**	1.14
	[0.26]	[0.24]	[0.23]	[0.23]	[0.21]
Some College	0.83**	0.84**	0.85**	0.86*	0.84**
	[0.07]	[0.07]	[0.07]	[0.07]	[0.07]
College Graduate or Above	0.76**	0.77**	0.79**	0.80*	0.90
	[0.09]	[0.09]	[0.09]	[0.09]	[0.12]
Black	0.85*	0.85*	0.86	0.87	1.25**
	[0.08]	[0.08]	[0.08]	[0.08]	[0.14]
Hispanic	0.99	0.99	1.00	1.01	1.33***
	[0.09]	[0.09]	[0.09]	[0.09]	[0.14]
Other Race	0.98	0.99	1.04	1.04	1.16

VARIABLES Reported as Odds ratio [SE]	MODEL (1) Demographics	MODEL (2) Demographics Combat Exposure	MODEL (3) Demographics Combat Exposure Lifestyle– Activities	MODEL (4) Demographics Combat Exposure Lifestyle– Activities Lifestyle– Nutrition	MODEL (5) Demographics Combat Exposure Lifestyle– Activities Lifestyle– Nutrition Lifestyle– Stress
	[0.12]	[0.13]	[0.13]	[0.13]	[0.18]
26–35	1.09	1.08	0.98	0.99	1.14
	[0.09]	[0.09]	[0.09]	[0.09]	[0.12]
36–45	1.02	1.01	0.88	0.88	1.17
	[0.11]	[0.11]	[0.10]	[0.10]	[0.16]
46–65	0.84	0.84	0.70**	0.71*	0.99
	[0.15]	[0.15]	[0.12]	[0.13]	[0.18]
Family Status	0.76***	0.75***	0.74***	0.75***	0.71***
	[0.05]	[0.05]	[0.05]	[0.05]	[0.05]
Low Combat Level		0.92	0.90	0.91	0.93
		[0.10]	[0.10]	[0.10]	[0.11]
High Combat Level		1.19*	1.17*	1.18*	0.91
		[0.10]	[0.10]	[0.10]	[0.09]
Deployed in the Past Year		1.06	1.08	1.07	1.11
		[0.08]	[0.08]	[0.08]	[0.09]
Under Weight			1.02	1.01	0.85
			[0.30]	[0.29]	[0.28]
Over Weight			1.24***	1.25***	1.10
			[0.09]	[0.09]	[0.09]
Normal Strength Training			0.64***	0.64***	0.75***
			[0.05]	[0.05]	[0.07]
High Strength Training			0.69***	0.69***	0.82**
			[0.05]	[0.06]	[0.07]
Under Active			1.42***	1.42***	1.21**
			[0.10]	[0.10]	[0.09]

VARIABLES Reported as Odds ratio [SE]	MODEL (1) Demographics	MODEL (2) Demographics Combat Exposure	MODEL (3) Demographics Combat Exposure Lifestyle– Activities	MODEL (4) Demographics Combat Exposure Lifestyle– Activities Lifestyle– Nutrition	MODEL (5) Demographics Combat Exposure Lifestyle– Activities Lifestyle– Nutrition Lifestyle– Stress
Over Active			1.15	1.15	1.11
			[0.11]	[0.11]	[0.12]
High Sugar Intake				0.99	1.00
				[0.07]	[0.08]
High Fried Intake				1.22***	1.12
				[0.08]	[0.09]
High Caffeine Intake				1.08	0.90
				[0.08]	[0.07]
Daily Supplement Intake				1.10	1.02
				[0.07]	[0.08]
High Stress					5.11***
					[0.47]
High Anxiety					6.67***
					[0.49]
Constant	0.18***	0.17***	0.19***	0.16***	0.04***
	[0.03]	[0.03]	[0.04]	[0.03]	[0.01]
Observations	31,721	31,721	31,721	31,721	31,721
seEform in brackets *** p<0.01, ** p<0.05, * p<0.1					

+ The following are reference groups for the variables listed: No fish oil use, Army, Combat Arms, Junior Enlisted, Male, < 1 year active duty, High School, White, 18–25, No Combat, Healthy Weight, and Less than one day a week Strength Training

With regard to the most comprehensive model, Model Five, the results show that the Navy, Air Force, and Coast Guard respondents had a lower likelihood of experiencing high depression incidences in comparison to the reference group, Army. In terms of occupation, relative to the reference group (Combat Arms), service members in Combat Support had .73 odds (i.e., lower odds), of experiencing high depression symptoms in the past week. The ranks of junior officer, senior officer, and senior enlisted all had a lower likelihood of experiencing incidences of high depression in the past week when compared to the reference group, junior enlisted. With regard to the education variables, personnel who completed some amount of college, but did not graduate from college, had .84 odds of experiencing high depressive symptoms in the past week in comparison to personnel who only had a high school degree or less. Interestingly, race become a significant factor once I control for high stress/high anxiety. In particular, African-American and Hispanics were 1.25 ($p<0.05$) and 1.33 ($p<0.01$) times more likely, respectively, to experience incidences of high depression in comparison to Whites only in Model 5.

When it came to activity levels, service members who performed one to two days a week of strength training had a lower likelihood of experiencing incidences of high depression in the past week in comparison to personnel who performed less than one day a week of strength training. The military members who were considered "underactive," which means moderate activity and vigorous activity equal less than 150 minutes per week and less than 75 minutes per week, respectively, were 1.21 times more likely to experience incidences of high depression in the past week.

Finally, both the stress and anxiety variables are significant in Model Five. The values show that service members who described themselves as experiencing high stress and high anxiety were 5.11 and 6.67 times more likely, respectively, to have high depressive incidences in the past week in comparison to personnel with lower levels of stress and anxiety. Unlike the other control variables, an incidence of stress and anxiety have very high odds of experiencing high levels of depression in the past week.

Table 4 displays regression analysis results with respect to the outcome variable PTS. Notably, daily fish oil use is significant in Models One through Four but insignificant in Model Five when the lifestyle-stress control variable is added. The higher

odds of high PTS among those who took fish oil daily might indicate a potential reverse causality (i.e., those who exhibited symptoms of high PTS might be advised to take fish oil on daily basis). This pattern of results suggest that there are omitted variables that may be causing bias in the fish oil values. When the regression is controlled for stress and anxiety in Model Five, fish oil use is no longer significant. This is not surprising given that stress and anxiety are highly correlated with (and in fact, are part of symptoms of) post-traumatic stress. Overall, I did not find evidence to indicate fish oil consumption lowers incidences of high PTS.

Table 4. PTS Regression Table

VARIABLES Reported as Odds ratio [SE]	MODEL (1) Demographics	MODEL (2) Demographics Combat Exposure	MODEL (3) Demographics Combat Exposure Lifestyle–Activities	MODEL (4) Demographics Combat Exposure Lifestyle–Activities Lifestyle–Nutrition	MODEL (5) Demographics Combat Exposure Lifestyle–Activities Lifestyle–Nutrition Lifestyle–Stress
Light Fish Oil Use	1.05	1.05	1.07	1.07	1.09
	[0.19]	[0.19]	[0.19]	[0.19]	[0.20]
Moderate Fish Oil Use	0.90	0.90	0.91	0.91	0.92
	[0.13]	[0.13]	[0.13]	[0.13]	[0.15]
Daily Fish Oil Use	1.27**	1.26**	1.27**	1.30**	1.21
	[0.13]	[0.13]	[0.14]	[0.15]	[0.16]
Navy	0.51***	0.61***	0.58***	0.57***	0.60***
	[0.06]	[0.07]	[0.07]	[0.07]	[0.08]
Marine Corps	0.89	0.96	0.94	0.94	0.88
	[0.10]	[0.11]	[0.11]	[0.11]	[0.11]
Air Force	0.29***	0.34***	0.34***	0.34***	0.56***
	[0.03]	[0.04]	[0.04]	[0.04]	[0.07]
Coast Guard	0.25***	0.33***	0.31***	0.30***	0.44***
	[0.03]	[0.05]	[0.05]	[0.05]	[0.08]
Combat Service Support	0.71***	0.77**	0.75**	0.75**	0.77*
	[0.09]	[0.09]	[0.09]	[0.09]	[0.10]
Combat Support	0.60***	0.64***	0.65***	0.65***	0.65**
	[0.10]	[0.11]	[0.10]	[0.10]	[0.11]
Headquarters and MPTE	0.85	0.91	0.92	0.91	0.97

VARIABLES Reported as Odds ratio [SE]	MODEL (1) Demographics	MODEL (2) Demographics Combat Exposure	MODEL (3) Demographics Combat Exposure Lifestyle–Activities	MODEL (4) Demographics Combat Exposure Lifestyle–Activities Lifestyle–Nutrition	MODEL (5) Demographics Combat Exposure Lifestyle–Activities Lifestyle–Nutrition Lifestyle–Stress
	[0.12]	[0.13]	[0.13]	[0.12]	[0.15]
Medical	0.83	0.88	0.87	0.87	0.89
	[0.14]	[0.15]	[0.15]	[0.15]	[0.17]
Other	0.49***	0.54***	0.54***	0.55***	0.59***
	[0.09]	[0.10]	[0.10]	[0.10]	[0.11]
Junior Officer	0.26***	0.25***	0.26***	0.25***	0.30***
	[0.05]	[0.05]	[0.05]	[0.05]	[0.07]
Senior Enlisted	0.55***	0.52***	0.55***	0.53***	0.52***
	[0.08]	[0.08]	[0.08]	[0.08]	[0.09]
Senior Officer	0.27***	0.24***	0.26***	0.25***	0.30***
	[0.07]	[0.06]	[0.07]	[0.06]	[0.09]
Female	1.53***	1.59***	1.64***	1.70***	1.05
	[0.13]	[0.14]	[0.15]	[0.15]	[0.11]
Short Active Duty 1–3 years	1.80***	1.66**	1.61**	1.61**	1.29
	[0.38]	[0.35]	[0.34]	[0.34]	[0.29]
Long Active Duty 10+ years	3.29***	2.63***	2.48***	2.46***	2.06**
	[0.87]	[0.73]	[0.69]	[0.68]	[0.63]
Medium Active Duty 4–9 years	2.89***	2.35***	2.21***	2.20***	1.73**
	[0.66]	[0.56]	[0.53]	[0.53]	[0.45]
Some College	0.75***	0.76**	0.78**	0.79**	0.78**
	[0.08]	[0.08]	[0.08]	[0.09]	[0.09]
College Graduate or Above	0.51***	0.52***	0.55***	0.57***	0.65**
	[0.08]	[0.09]	[0.09]	[0.09]	[0.12]

VARIABLES Reported as Odds ratio [SE]	MODEL (1) Demographics	MODEL (2) Demographics Combat Exposure	MODEL (3) Demographics Combat Exposure Lifestyle–Activities	MODEL (4) Demographics Combat Exposure Lifestyle–Activities Lifestyle–Nutrition	MODEL (5) Demographics Combat Exposure Lifestyle–Activities Lifestyle–Nutrition Lifestyle–Stress
Black	0.83	0.86	0.84	0.90	1.38**
	[0.11]	[0.12]	[0.11]	[0.12]	[0.22]
Hispanic	1.31**	1.32**	1.31**	1.37***	2.00***
	[0.15]	[0.16]	[0.15]	[0.16]	[0.26]
Other Race	1.43**	1.49**	1.53***	1.56***	1.79***
	[0.23]	[0.24]	[0.24]	[0.25]	[0.34]
26–35	1.09	1.07	0.96	0.95	1.09
	[0.13]	[0.13]	[0.12]	[0.12]	[0.15]
36–45	0.89	0.88	0.77*	0.74*	1.01
	[0.13]	[0.13]	[0.12]	[0.11]	[0.19]
46–65	1.03	1.02	0.85	0.84	1.31
	[0.25]	[0.25]	[0.21]	[0.21]	[0.34]
Family Status	0.94	0.93	0.93	0.93	0.90
	[0.09]	[0.09]	[0.09]	[0.09]	[0.09]
Low Combat Level		0.79	0.78	0.79	0.81
		[0.14]	[0.14]	[0.14]	[0.15]
High Combat Level		1.57***	1.55***	1.56***	1.21
		[0.21]	[0.21]	[0.21]	[0.17]
Deployed in the Past Year		1.05	1.06	1.05	1.16
		[0.11]	[0.11]	[0.11]	[0.13]
Under Weight			0.81	0.84	0.75
			[0.32]	[0.32]	[0.30]
Over Weight			1.26**	1.27**	1.06

VARIABLES Reported as Odds ratio [SE]	MODEL (1) Demographics	MODEL (2) Demographics Combat Exposure	MODEL (3) Demographics Combat Exposure Lifestyle– Activities	MODEL (4) Demographics Combat Exposure Lifestyle– Activities Lifestyle– Nutrition	MODEL (5) Demographics Combat Exposure Lifestyle– Activities Lifestyle– Nutrition Lifestyle– Stress
			[0.12]	[0.12]	[0.11]
Normal Strength Training			0.67***	0.67***	0.84
			[0.08]	[0.08]	[0.11]
High Strength Training			0.93	0.95	1.22
			[0.10]	[0.11]	[0.15]
Under Active			1.73***	1.71***	1.47***
			[0.17]	[0.17]	[0.16]
Over Active			1.21	1.21	1.20
			[0.15]	[0.15]	[0.17]
High Sugar Intake				0.89	0.90
				[0.08]	[0.09]
High Fried Intake				1.21**	1.06
				[0.11]	[0.11]
High Caffeine Intake				1.38***	1.17
				[0.14]	[0.13]
Daily Supplement Intake				0.95	0.86
				[0.09]	[0.09]
High Stress					4.80***
					[0.75]
High Anxiety					12.57***
					[1.41]
Constant	0.07***	0.06***	0.06***	0.04***	0.01***
	[0.02]	[0.01]	[0.01]	[0.01]	[0.00]

VARIABLES Reported as Odds ratio [SE]	MODEL (1) Demographics	MODEL (2) Demographics Combat Exposure	MODEL (3) Demographics Combat Exposure Lifestyle–Activities	MODEL (4) Demographics Combat Exposure Lifestyle–Activities Lifestyle–Nutrition	MODEL (5) Demographics Combat Exposure Lifestyle–Activities Lifestyle–Nutrition Lifestyle–Stress
Observations	31,413	31,413	31,413	31,413	31,413
seEform in brackets *** p<0.01, ** p<0.05, * p<0.1					

+ The following are reference groups for the variables listed: No fish oil use, Army, Combat Arms, Junior Enlisted, Male, < 1 year active duty, High School, White, 18–25, No Combat, Healthy Weight, and Less than one day a week Strength Training

The regressions show that, among other control variables, the Navy, Air Force, and Coast Guard respondents were less likely to experience high PTS symptoms in the past 30 days in comparison to Army personnel. Of significance, Combat Service Support, Combat Support, and Other personnel were less likely to experience high PTS symptoms in the past 30 days relative to reference group (Combat Arms). Similar to the depression results, junior officer, senior officer, and senior enlisted all had a lower likelihood than junior enlisted of experiencing high PTS in the past 30 days. Interestingly, longer time on active duty is associated with higher odds of high PTS. Compared to those who were on active duty less than 1 year, military members with 4–9 years on active duty and with 10 or more years on active duty were 1.73 and 2.06 times more likely, respectively, to experience high PTS over the past 30 days ($p<0.05$). When it comes to education, personnel who had some amount of college as well as a college degree were less likely to experience high PTS in the past 30 days in comparison to personnel with an education of high school or below. Notably, similar to the Hispanic race in the depression regressions, the race, African American, is not significant until Model Five when stress and anxiety are included. African American service members were 1.38 times more likely to experience high PTS in comparison to the reference group, White. Both Hispanic and Other races are significant across all five models, and in particular, Model Five shows that these races were 2.00 and 1.79 times more likely, respectively, to have high PTS in the past 30 days than White military members.

The variable, underactive, displays the same trend in both the depression and PTS regressions. Military personnel who were underactive were 1.47 times more likely to experience high PTS in the past 30 days. Finally, personnel with high incidence of stress were 4.80 times more likely to experience high PTS symptoms in the past 30 days and personnel with a high incidence of anxiety were 12.57 times more likely to experience high PTS symptoms in the past 30 days.

Table 5 displays the results of the outcome variable, suicide ideation. As shown, the key independent variable, fish oil use, is insignificant across the different specifications. Simply put, I do not find fish oil consumption levels to be associated with incidences of suicide ideation within that year.

Table 5. Suicide Ideation Regression Table

VARIABLES Reported as Odds ratio [SE]	MODEL (1) Demographics	MODEL (2) Demographics Combat Exposure	MODEL (3) Demographics Combat Exposure Lifestyle–Activities	MODEL (4) Demographics Combat Exposure Lifestyle–Activities Lifestyle–Nutrition	MODEL (5) Demographics Combat Exposure Lifestyle–Activities Lifestyle–Nutrition Lifestyle–Stress
Light Fish Oil Use	0.72	0.72	0.73	0.73	0.72
	[0.15]	[0.15]	[0.15]	[0.15]	[0.16]
Moderate Fish Oil Use	0.83	0.83	0.85	0.84	0.83
	[0.13]	[0.13]	[0.14]	[0.14]	[0.13]
Daily Fish Oil Use	0.89	0.89	0.94	0.89	0.84
	[0.10]	[0.10]	[0.11]	[0.11]	[0.11]
Navy	0.70***	0.78*	0.73**	0.73**	0.77*
	[0.09]	[0.11]	[0.10]	[0.10]	[0.11]
Marine Corps	1.15	1.18	1.17	1.17	1.11
	[0.15]	[0.15]	[0.15]	[0.15]	[0.15]
Air Force	0.40***	0.43***	0.43***	0.43***	0.61***
	[0.05]	[0.05]	[0.05]	[0.05]	[0.08]
Coast Guard	0.47***	0.51***	0.49***	0.49***	0.65**
	[0.07]	[0.09]	[0.08]	[0.08]	[0.11]
Combat Service Support	1.06	1.10	1.06	1.05	1.13
	[0.15]	[0.15]	[0.14]	[0.14]	[0.16]
Combat Support	0.87	0.90	0.89	0.88	0.92
	[0.15]	[0.16]	[0.16]	[0.16]	[0.16]
Headquarters and MPTE	0.93	0.95	0.94	0.94	1.02
	[0.14]	[0.14]	[0.14]	[0.14]	[0.16]
Medical	1.12	1.12	1.10	1.10	1.15
	[0.20]	[0.20]	[0.20]	[0.20]	[0.21]

VARIABLES Reported as Odds ratio [SE]	MODEL (1) Demographics	MODEL (2) Demographics Combat Exposure	MODEL (3) Demographics Combat Exposure Lifestyle– Activities	MODEL (4) Demographics Combat Exposure Lifestyle– Activities Lifestyle– Nutrition	MODEL (5) Demographics Combat Exposure Lifestyle– Activities Lifestyle– Nutrition Lifestyle– Stress
Other	0.66**	0.68**	0.68**	0.68**	0.73*
	[0.12]	[0.12]	[0.12]	[0.12]	[0.14]
Junior Officer	0.56***	0.55***	0.56***	0.57***	0.70*
	[0.12]	[0.11]	[0.12]	[0.12]	[0.15]
Senior Enlisted	0.92	0.91	0.94	0.94	1.00
	[0.15]	[0.16]	[0.16]	[0.16]	[0.17]
Senior Officer	0.70	0.68	0.71	0.71	0.93
	[0.18]	[0.18]	[0.19]	[0.19]	[0.25]
Female	1.28***	1.30***	1.33***	1.34***	0.95
	[0.11]	[0.12]	[0.13]	[0.13]	[0.10]
Short Active Duty 1–3 years	1.53*	1.51*	1.45	1.45	1.26
	[0.35]	[0.35]	[0.33]	[0.33]	[0.29]
Long Active Duty 10+ years	1.72**	1.63*	1.52	1.54	1.33
	[0.45]	[0.44]	[0.40]	[0.41]	[0.36]
Medium Active Duty 4–9 years	1.56*	1.49*	1.38	1.38	1.14
	[0.36]	[0.35]	[0.32]	[0.32]	[0.27]
Some College	1.01	1.01	1.03	1.03	1.05
	[0.12]	[0.12]	[0.13]	[0.13]	[0.13]
College Graduate or Above	1.04	1.05	1.09	1.10	1.23
	[0.19]	[0.19]	[0.20]	[0.20]	[0.23]
Black	0.79*	0.80	0.81	0.80	1.02
	[0.11]	[0.11]	[0.11]	[0.11]	[0.15]
Hispanic	0.74**	0.75**	0.75**	0.75**	0.88
	[0.10]	[0.10]	[0.11]	[0.11]	[0.13]
Other Race	0.91	0.92	0.97	0.97	1.02

VARIABLES Reported as Odds ratio [SE]	MODEL (1) Demographics	MODEL (2) Demographics Combat Exposure	MODEL (3) Demographics Combat Exposure Lifestyle– Activities	MODEL (4) Demographics Combat Exposure Lifestyle– Activities Lifestyle– Nutrition	MODEL (5) Demographics Combat Exposure Lifestyle– Activities Lifestyle– Nutrition Lifestyle– Stress
	[0.18]	[0.19]	[0.20]	[0.20]	[0.21]
26–35	0.96	0.96	0.85	0.85	0.92
	[0.12]	[0.12]	[0.11]	[0.11]	[0.12]
36–45	0.68**	0.67**	0.56***	0.56***	0.67**
	[0.11]	[0.11]	[0.09]	[0.10]	[0.12]
46–65	0.81	0.80	0.65*	0.66*	0.85
	[0.18]	[0.17]	[0.15]	[0.15]	[0.20]
Family Status	0.61***	0.60***	0.59***	0.60***	0.58***
	[0.06]	[0.06]	[0.06]	[0.06]	[0.06]
Low Combat Level		0.71**	0.70**	0.71**	0.71**
		[0.12]	[0.12]	[0.12]	[0.12]
High Combat Level		1.17	1.16	1.17	0.98
		[0.16]	[0.16]	[0.16]	[0.13]
Deployed in the Past Year		1.01	1.03	1.03	1.03
		[0.11]	[0.11]	[0.11]	[0.11]
Under Weight			1.15	1.13	0.99
			[0.50]	[0.49]	[0.45]
Over Weight			1.38***	1.39***	1.23**
			[0.14]	[0.14]	[0.13]
Normal Strength Training			0.76**	0.76**	0.89
			[0.09]	[0.09]	[0.11]
High Strength Training			0.74***	0.73***	0.85
			[0.08]	[0.08]	[0.10]
Under Active			1.27**	1.27**	1.08
			[0.13]	[0.13]	[0.12]

VARIABLES Reported as Odds ratio [SE]	MODEL (1) Demographics	MODEL (2) Demographics Combat Exposure	MODEL (3) Demographics Combat Exposure Lifestyle– Activities	MODEL (4) Demographics Combat Exposure Lifestyle– Activities Lifestyle– Nutrition	MODEL (5) Demographics Combat Exposure Lifestyle– Activities Lifestyle– Nutrition Lifestyle– Stress
Over Active			0.99	0.98	0.93
			[0.14]	[0.14]	[0.14]
High Sugar Intake				1.11	1.12
				[0.11]	[0.12]
High Fried Intake				1.14	1.04
				[0.12]	[0.11]
High Caffeine Intake				0.98	0.86
				[0.10]	[0.09]
Daily Supplement Intake				1.15	1.07
				[0.11]	[0.11]
High Stress					3.42***
					[0.45]
High Anxiety					4.25***
					[0.46]
Constant	0.06***	0.06***	0.06***	0.05***	0.02***
	[0.02]	[0.02]	[0.02]	[0.02]	[0.01]
Observations	31,636	31,636	31,636	31,636	31,636
seEform in brackets *** p<0.01, ** p<0.05, * p<0.1					

+ The following are reference groups for the variables listed: No fish oil use, Army, Combat Arms, Junior Enlisted, Male, < 1 year active duty, High School, White, 18–25, No Combat, Healthy Weight, and Less than one day a week Strength Training

Other values of interest for the suicide ideation regression are the control variables concerning branch of service, age, family status, combat level, weight, stress, and anxiety. For example, the Navy, Air Force, and Coast Guard respondents had a lower likelihood of experiencing suicide ideation within the past year in comparison to Army personnel. Notably, the control variable, female, is significant for Models One through Four but when stress and anxiety is added to Model Five, female no longer is significant. Therefore, this means that a person's gender does not result in an increased or decreased likelihood for suicide ideation—in Models One through Four, the female indicator was just picking up omitted characteristics of women in this population that are correlated with suicide ideation. After directly controlling for stress and anxiety in Model Five, the coefficient on the female dummy becomes insignificant. Interestingly, race variables were not significant with respect to suicide ideation in the past year. Unlike the other outcome variables, age became a significant factor in the regression results for suicide ideation. The data shows that military personnel age 36–45 had .67 odds of experiencing suicide ideation in the last year when compared to 18–25 year olds. Similar to the depression regression, personnel who were married had .58 odds of experiencing suicide ideation in the last year when compared to singles.

Another new and interesting finding, which was not present in previous regressions, is the significance of combat level. Uncharacteristically, personnel who experienced low levels of combat have lower odds ($OR=0.71$, $p<0.05$) of experiencing suicide ideation in the past year when compared to the reference group who had no combat experience. Lifestyle factors seem to play an important role in this regression. Personnel who were overweight were 1.23 times more likely to experience suicide ideation in comparison to personnel who were of healthy weight. Finally, as shown in previous regressions, stress and anxiety can have a large impact on a person's health. Military members who had high levels of stress were 3.42 times more likely to have occurrences of suicide ideation in the past year when compared to service members with low levels of stress. As well, service members who had high levels of anxiety were 4.25 times more likely to experience suicide ideation in the past year compared to those personnel with low anxiety levels.

Table 6 displays fish oil use with respect to whether a service member sought mental health therapy in the past year from either a military or civilian health professional. Notably, consumption of daily fish oil among military members is associated with higher odds of mental health therapy (OR ranged from 1.21 to 1.29 across the models, all $p<0.01$). When it comes to the most comprehensive model, Model Five, personnel who consumed daily fish oil had a 1.23 times higher likelihood of seeking mental health therapy than those who did not consume fish oil. This finding could be explained by reverse causality. Health professionals may have suggested that the military members take fish oil to benefit their own health.

Table 6. Mental Health Therapy Regression Table

VARIABLES Reported as Odds ratio [SE]	MODEL (1) Demographics	MODEL (2) Demographics Combat Exposure	MODEL (3) Demographics Combat Exposure Lifestyle–Activities	MODEL (4) Demographics Combat Exposure Lifestyle–Activities Lifestyle–Nutrition	MODEL (5) Demographics Combat Exposure Lifestyle–Activities Lifestyle–Nutrition Lifestyle–Stress
Light Fish Oil Use	1.01	1.02	1.03	1.03	1.03
	[0.10]	[0.10]	[0.10]	[0.10]	[0.11]
Moderate Fish Oil Use	0.99	1.01	1.03	1.03	1.04
	[0.08]	[0.09]	[0.09]	[0.09]	[0.09]
Daily Fish Oil Use	1.22***	1.21***	1.29***	1.24***	1.23***
	[0.07]	[0.07]	[0.08]	[0.08]	[0.08]
Navy	0.52***	0.65***	0.61***	0.61***	0.61***
	[0.03]	[0.04]	[0.04]	[0.04]	[0.04]
Marine Corps	0.61***	0.69***	0.68***	0.68***	0.61***
	[0.04]	[0.05]	[0.05]	[0.05]	[0.04]
Air Force	0.52***	0.65***	0.63***	0.63***	0.76***
	[0.03]	[0.03]	[0.03]	[0.03]	[0.04]
Coast Guard	0.44***	0.83**	0.78***	0.78***	0.82**
	[0.03]	[0.06]	[0.06]	[0.06]	[0.07]
Combat Service Support	0.85**	0.95	0.91	0.91	0.94
	[0.06]	[0.07]	[0.06]	[0.06]	[0.07]
Combat Support	0.88	0.98	0.95	0.95	0.97
	[0.08]	[0.09]	[0.09]	[0.09]	[0.09]
Headquarters and MPTE	0.94	1.06	1.04	1.04	1.09
	[0.07]	[0.08]	[0.08]	[0.08]	[0.09]
Medical	1.23**	1.51***	1.46***	1.47***	1.50***
	[0.11]	[0.13]	[0.13]	[0.13]	[0.14]

VARIABLES Reported as Odds ratio [SE]	MODEL (1) Demographics	MODEL (2) Demographics Combat Exposure	MODEL (3) Demographics Combat Exposure Lifestyle–Activities	MODEL (4) Demographics Combat Exposure Lifestyle–Activities Lifestyle–Nutrition	MODEL (5) Demographics Combat Exposure Lifestyle–Activities Lifestyle–Nutrition Lifestyle–Stress
Other	0.85*	0.99	0.99	0.98	1.01
	[0.08]	[0.09]	[0.09]	[0.09]	[0.10]
Junior Officer	0.48***	0.40***	0.40***	0.40***	0.44***
	[0.05]	[0.04]	[0.04]	[0.04]	[0.05]
Senior Enlisted	0.67***	0.57***	0.59***	0.59***	0.59***
	[0.06]	[0.05]	[0.05]	[0.05]	[0.05]
Senior Officer	0.40***	0.30***	0.31***	0.31***	0.35***
	[0.05]	[0.04]	[0.04]	[0.04]	[0.05]
Female	2.02***	2.18***	2.17***	2.14***	1.73***
	[0.09]	[0.10]	[0.10]	[0.10]	[0.09]
Short Active Duty 1–3 years	1.84***	1.65***	1.60***	1.60***	1.55***
	[0.24]	[0.21]	[0.21]	[0.21]	[0.21]
Long Active Duty 10+ years	3.48***	2.19***	2.07***	2.07***	2.13***
	[0.51]	[0.31]	[0.29]	[0.29]	[0.32]
Medium Active Duty 4–9 years	2.68***	1.76***	1.67***	1.67***	1.65***
	[0.36]	[0.23]	[0.22]	[0.22]	[0.23]
Some College	1.08	1.09	1.12*	1.11	1.13*
	[0.07]	[0.07]	[0.07]	[0.07]	[0.08]
College Graduate or Above	0.90	0.94	0.97	0.97	1.02
	[0.08]	[0.08]	[0.09]	[0.09]	[0.10]
Black	0.78***	0.84**	0.85**	0.85**	1.06
	[0.05]	[0.06]	[0.06]	[0.06]	[0.08]
Hispanic	0.81***	0.85**	0.85**	0.85**	0.99
	[0.06]	[0.06]	[0.06]	[0.06]	[0.07]

VARIABLES Reported as Odds ratio [SE]	MODEL (1) Demographics	MODEL (2) Demographics Combat Exposure	MODEL (3) Demographics Combat Exposure Lifestyle–Activities	MODEL (4) Demographics Combat Exposure Lifestyle–Activities Lifestyle–Nutrition	MODEL (5) Demographics Combat Exposure Lifestyle–Activities Lifestyle–Nutrition Lifestyle–Stress
Other Race	0.61***	0.66***	0.68***	0.68***	0.70***
	[0.07]	[0.07]	[0.07]	[0.08]	[0.08]
26–35	1.13**	1.09	1.00	1.00	1.08
	[0.07]	[0.07]	[0.07]	[0.07]	[0.08]
36–45	1.18**	1.11	0.97	0.98	1.13
	[0.10]	[0.09]	[0.08]	[0.08]	[0.10]
46–65	1.07	1.04	0.89	0.89	1.08
	[0.13]	[0.12]	[0.11]	[0.11]	[0.14]
Family Status	1.04	1.03	1.01	1.01	1.00
	[0.05]	[0.05]	[0.05]	[0.05]	[0.05]
Low Combat Level		1.84***	1.80***	1.80***	1.51***
		[0.15]	[0.15]	[0.14]	[0.13]
High Combat Level		3.40***	3.39***	3.38***	2.46***
		[0.21]	[0.22]	[0.21]	[0.16]
Deployed in the Past Year		0.92	0.93	0.94	0.90*
		[0.05]	[0.05]	[0.05]	[0.05]
Under Weight			1.98***	1.98***	1.93***
			[0.45]	[0.45]	[0.41]
Over Weight			1.23***	1.23***	1.14**
			[0.06]	[0.06]	[0.06]
Normal Strength Training			0.83***	0.83***	0.93
			[0.05]	[0.05]	[0.06]
High Strength Training			0.78***	0.77***	0.87**
			[0.05]	[0.05]	[0.05]

VARIABLES Reported as Odds ratio [SE]	MODEL (1) Demographics	MODEL (2) Demographics Combat Exposure	MODEL (3) Demographics Combat Exposure Lifestyle–Activities	MODEL (4) Demographics Combat Exposure Lifestyle–Activities Lifestyle–Nutrition	MODEL (5) Demographics Combat Exposure Lifestyle–Activities Lifestyle–Nutrition Lifestyle–Stress
Under Active			1.30***	1.31***	1.19***
			[0.07]	[0.07]	[0.07]
Over Active			0.84**	0.84**	0.81***
			[0.06]	[0.06]	[0.06]
High Sugar Intake				1.07	1.06
				[0.05]	[0.05]
High Fried Intake				0.94	0.88**
				[0.05]	[0.05]
High Caffeine Intake				0.98	0.90*
				[0.05]	[0.05]
Daily Supplement Intake				1.08	1.04
				[0.05]	[0.06]
High Stress					2.86***
					[0.16]
High Anxiety					3.05***
					[0.19]
Constant	0.10***	0.07***	0.08***	0.08***	0.04***
	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
Observations	39,379	39,379	39,379	39,379	39,379
seEform in brackets *** p<0.01, ** p<0.05, * p<0.1					

+ The following are reference groups for the variables listed: No fish oil use, Army, Combat Arms, Junior Enlisted, Male, < 1 year active duty, High School, White, 18–25, No Combat, Healthy Weight, and Less than one day a week Strength Training

Relative to the Army, respondents from all other military services (Navy, Marine Corps, Air Force, and Coast Guard) had lower likelihood to seek therapy in the past year from a mental health care professional (OR ranged from 0.44–0.83, all either $p<0.01$ or $p<0.05$). In terms of occupation, the results show that Medical personnel were 1.50 times more likely than Combat Arms personnel to seek mental health therapy in the past year. Each of the ranks, junior officer, senior enlisted, and senior officer, had a lower likelihood of seeking out mental health therapy from a health care professional in the past year in comparison to the reference group, junior enlisted. Of significant note, senior officers had the lowest odds of seeking out mental health therapy from a mental health care professional (OR=.35, $p<0.01$). In addition, females were 1.73 times more likely than men ($p<0.01$) to seek mental health therapy in the past year from a health professional. In general, longer time in active duty is associated with higher odds of seeking mental health therapy. With regard to education, personnel who completed some amount of college were 1.13 times more likely to seek mental health therapy from a health professional in the past year than personnel who only completed high school or below.

Both low combat and high combat levels are significant across all models. In Model Five, for example, personnel who experienced low and high combat levels were 1.51 times and 2.46 times, respectively, more likely to seek mental health therapy from a health professional in the past year than those personnel who have not experienced any combat. When it came to lifestyle and nutrition, a large number of the control variables were significant across the models. When looking at the most comprehensive model, Model Five, military personnel who were both underweight and overweight were more likely to seek mental health therapy in the past year in comparison to the reference group, healthy weight (OR=1.93 and 1.14, respectively, and $p<0.01$ and $p<0.05$, respectively). Service members who performed high strength training had .87 odds of seeking mental health therapy in the past year compared to the reference group, low strength training. As well, personnel who were considered underactive had 1.19 times more likelihood of seeking mental health therapy whereas personnel who were considered overactive had .81 odds of seeking mental health therapy in the past year. Personnel who consumed high

levels of fried foods and caffeine (at least three to six times a week) had .88 odds and .90 odds, respectively, of seeking mental health therapy in the past year. This result could be due in part to personnel who are more health conscious seek treatments versus non-health conscious personnel. Finally, military members who classified themselves as having both high stress and high anxiety were 2.86 and 3.05 times, respectively, more likely to seek mental health therapy in the past year in comparison to personnel who possessed low stress and low anxiety.

C. ADDITIONAL ANALYSIS BY GENDER AND NAVY

The female-fish oil use interaction variables were added to Model Five, the most comprehensive model. Table 7 reports the abbreviated results showing the original fish oil consumption level indicators and the three interaction terms with female indicator. The discussion here focuses on the interaction terms, since the rest of the results mirror the discussions in previous sections on Model Five. In order to test whether the effect of fish oil use varies by gender, I looked at the interaction variables between female service members and fish oil consumption (Buis, M., 2010). The data shows for service members who have consumed light levels of fish oil, female is 1.57 times likely than male ($p<0.1$) to report high depressive symptoms in the past week. The same pattern is also present in the model for PTS. For service members with light and moderate fish oil use, female are 1.84 ($p<0.1$) and 1.95 ($p<0.05$) times more likely, respectively, than male to report high PTS symptoms in the past 30 days.

Table 7. Gender Interaction Regression Table Based on Model Five

VARIABLES Reported as Odds ratio [SE]	Depression	PTS	Suicide Ideation	Mental Health Therapy
Light Fish Oil Use	0.89	0.97	0.68	0.97
	[0.16]	[0.22]	[0.18]	[0.12]
Moderate Fish Oil Use	0.96	0.80	0.81	1.02
	[0.15]	[0.16]	[0.15]	[0.11]
Daily Fish Oil Use	1.08	1.20	0.83	1.25***
	[0.12]	[0.18]	[0.12]	[0.10]
Female*Light Fish Oil Interaction Variable	1.57*	1.84*	1.38	1.32
	[0.41]	[0.61]	[0.51]	[0.23]
Female*Moderate Fish Oil Interaction Variable	0.77	1.95**	1.16	1.11
	[0.19]	[0.61]	[0.36]	[0.18]
Female*Daily Fish Oil Interaction Variable	0.84	1.04	1.11	0.89
	[0.13]	[0.23]	[0.24]	[0.10]
Constant	0.04***	0.01***	0.02***	0.04***
	[0.01]	[0.00]	[0.01]	[0.01]
Observations	31,721	31,413	31,636	39,379
seEform in brackets *** p<0.01, ** p<0.05, * p<0.1				

+ The following are reference groups for the variables listed: No fish oil use, Army, Combat Arms, Junior Enlisted, Male, < 1 year active duty, High School, White, 18–25, No Combat, Healthy Weight, and Less than one day a week Strength Training

++ Complete results on the rest of the variables are similar to those reported in Tables 3–6 and are available upon request.

Table 8, the last table presented, shows results for only the Navy population using the sample weights of the survey and Model Five. When limiting the analysis to Navy only, an interesting finding shows that light fish oil use is associated with .50 odds of experiencing high PTS symptoms in the past 30 days. However, further investigation revealed that the results might be driven by missing value patterns—when dummies for the missing indicators for all the control variables where the missing are coded as zeros are included in the regression, the association between lower PTS outcome and light fish oil use is no longer significant.[2] Lastly, daily fish oil consumption is associated with higher odds of Depression (OR=1.54, $p<0.05$) and higher odds of seeking mental health professionals (OR=1.50, $p<0.01$).

[2] Robustness check shows light fish oil use is not robust when dummies for missing indicators are included in regression.

Table 8. Navy Regression Table Based on Model Five

VARIABLES Reported as Odds ratio [SE]	Depression	PTS	Suicide Ideation	Mental Health Therapy
Light Fish Oil Use	1.07	0.50*	0.65	1.16
	[0.32]	[0.20]	[0.28]	[0.24]
Moderate Fish Oil Use	0.83	0.76	0.81	1.16
	[0.22]	[0.24]	[0.30]	[0.22]
Daily Fish Oil Use	1.54**	1.42	0.83	1.50***
	[0.29]	[0.40]	[0.23]	[0.20]
Combat Service Support	0.88	0.52**	1.62	0.68**
	[0.21]	[0.17]	[0.61]	[0.13]
Combat Support	0.54**	0.38**	1.71	1.14
	[0.16]	[0.16]	[0.78]	[0.26]
Headquarters and MPTE	0.74	0.49*	0.93	1.13
	[0.18]	[0.18]	[0.40]	[0.21]
Medical	1.36	1.03	1.62	1.59**
	[0.34]	[0.34]	[0.67]	[0.30]
Other	0.89	0.67	1.11	0.89
	[0.24]	[0.24]	[0.49]	[0.19]
Junior Officer	0.46***	0.51	0.55	0.41***
	[0.14]	[0.24]	[0.23]	[0.09]
Senior Enlisted	1.25	1.34	1.11	0.67**
	[0.28]	[0.43]	[0.36]	[0.12]
Senior Officer	0.60	0.75	0.61	0.38***
	[0.23]	[0.43]	[0.32]	[0.11]
Female	1.08	1.47*	0.94	1.79***
	[0.14]	[0.30]	[0.19]	[0.19]
Short Active Duty 1–3 years	1.05	1.77	0.87	0.77
	[0.47]	[1.21]	[0.65]	[0.28]
Long Active Duty 10+ years	0.57	1.20	0.54	0.94

VARIABLES Reported as Odds ratio [SE]	Depression	PTS	Suicide Ideation	Mental Health Therapy
	[0.26]	[0.84]	[0.41]	[0.33]
Medium Active Duty 4–9 years	0.94	1.60	0.61	0.71
	[0.42]	[1.09]	[0.45]	[0.25]
Some College	0.78	0.80	1.17	1.29*
	[0.13]	[0.18]	[0.29]	[0.18]
College Graduate or Above	1.14	0.94	1.52	1.40*
	[0.27]	[0.41]	[0.50]	[0.25]
Black	1.53**	1.03	0.93	0.83
	[0.30]	[0.34]	[0.29]	[0.13]
Hispanic	1.59**	2.12***	0.75	1.13
	[0.32]	[0.59]	[0.24]	[0.16]
Other Race	0.93	2.24***	0.61	0.55***
	[0.25]	[0.68]	[0.23]	[0.12]
26–35	1.07	0.86	0.91	1.03
	[0.21]	[0.24]	[0.24]	[0.14]
36–45	1.54*	0.53*	1.03	1.03
	[0.40]	[0.20]	[0.34]	[0.19]
46–65	1.28	1.21	2.22*	1.12
	[0.44]	[0.61]	[0.93]	[0.27]
Family Status	0.69***	1.09	0.92	1.05
	[0.10]	[0.23]	[0.20]	[0.12]
Low Combat Level	1.00	0.99	0.66	1.59***
	[0.19]	[0.29]	[0.19]	[0.23]
High Combat Level	1.10	1.23	1.33	2.22***
	[0.19]	[0.32]	[0.36]	[0.31]
Deployed in the Past Year	1.24	1.22	1.49*	0.80*
	[0.19]	[0.28]	[0.35]	[0.10]
Under Weight	0.53	0.52	0.71	1.05
	[0.34]	[0.52]	[0.49]	[0.44]
Over Weight	1.12	1.32	1.28	1.02
	[0.17]	[0.28]	[0.27]	[0.11]

VARIABLES Reported as Odds ratio [SE]	Depression	PTS	Suicide Ideation	Mental Health Therapy
Normal Strength Training	0.92	1.05	1.07	0.78*
	[0.15]	[0.27]	[0.27]	[0.10]
High Strength Training	1.00	1.26	0.91	0.80*
	[0.17]	[0.32]	[0.22]	[0.10]
Under Active	1.09	0.97	0.98	1.06
	[0.16]	[0.22]	[0.21]	[0.12]
Over Active	0.76	1.28	1.24	0.80
	[0.17]	[0.36]	[0.36]	[0.14]
High Sugar Intake	1.07	1.16	1.51**	1.28**
	[0.16]	[0.26]	[0.31]	[0.14]
High Fried Intake	1.03	1.12	0.95	0.69***
	[0.15]	[0.25]	[0.20]	[0.08]
High Caffeine Intake	1.07	1.52*	0.72	0.86
	[0.16]	[0.34]	[0.15]	[0.10]
Daily Supplement Intake	0.78*	0.62**	1.24	1.07
	[0.11]	[0.14]	[0.26]	[0.12]
High Stress	4.81***	5.83***	4.46***	3.18***
	[0.83]	[1.86]	[1.29]	[0.38]
High Anxiety	6.49***	11.22***	4.00***	2.69***
	[0.90]	[2.61]	[0.85]	[0.34]
Constant	0.02***	0.00***	0.01***	0.05***
	[0.01]	[0.00]	[0.01]	[0.02]
Observations	5,926	5,868	5,925	7,487
seEform in brackets *** p<0.01, ** p<0.05, * p<0.1				

+ The following are reference groups for the variables listed: No fish oil use, Army, Combat Arms, Junior Enlisted, Male, < 1 year active duty, High School, White, 18–25, No Combat, Healthy Weight, and Less than one day a week Strength Training

When it comes to mental health therapy, the results show that Navy service members who experienced low and high combat exposure in comparison to someone that experienced none, are 1.59 and 2.22 times, respectively, more likely to seek mental health therapy versus personnel who did not experience any combat exposure. Those who were deployed in the past year are 1.49 times ($p<0.1$) more likely to have suicide ideation in the past year in comparison to those personnel not deployed but have lower odds of seeking mental health therapy (OR=0.8, $p<0.1$). Across all the outcome variables, the results indicate that for the Navy personnel, high stress and high anxiety are associated with higher odds of experiencing any of the mental health outcomes examined in this thesis (OR ranged from 2.69 to 11.22, all $p<0.01$). A final result of significance is that Navy personnel who consumed daily supplements have a .78 odds and .62 odds of experiencing high depressive symptoms in the past week and high PTS symptoms in the past 30 days, respectively ($p< 0.1$ and $p<0.05$, respectively).

D. KEY FINDINGS

The results have been illuminating as to what control variables lead to increased and decreased odds of high depression, high PTS, suicide ideation, and mental health therapy. But, in general, I did not find evidence to support the claim that fish oil consumption is associated with lower incidences of mental health problems. Rather, the results are suggestive of possible reverse causality, in that some people with certain mental health conditions might be advised to take fish oil on daily basis.

Another interesting finding is how much the odds are increased of experiencing high depression, high PTS, and suicide ideation when personnel have high levels of stress and anxiety. In particular, a person who has a high level of anxiety shows a very high likelihood of experiencing high PTS symptoms in the past 30 days and a service member that has a high level of stress displays a very high likelihood of experiencing high depressive symptoms in the past week. Other findings of note are the effects of lifestyle choices. For the most part, healthy lifestyles among military personnel appear to be associated with a lower likelihood of experiencing high depression, high PTS, and suicide ideation. Most service members who were underactive, overweight, and did not partake

in strength training seemed to experience high depression symptoms, high PTS symptoms, and suicide ideation.

V. CONCLUSION AND RECOMMENDATIONS

I initiated this research due to the growing number of military members seeking help for mental health issues. Mental health is not only an individual problem; it is a societal problem. The military prides itself on recruiting the best and the brightest America has to offer. These men and women may be the best and the brightest, but they are not necessarily the healthiest. The military's "nutritional armor" needs some repairing, and because of this, the DOD needs to place more of an emphasis on nutrition and lifestyle choices as key components in the prevention of illnesses (Carmona, 2014, p. 176). Correcting fish oil levels in our military members' diets may not be the full answer, but it is a starting point that may ultimately change the incidence of mental health issues.

In this thesis, I sought answers to the following research questions.

1. Does the use of fish oil lower the incidence of depression, post-traumatic stress, or suicide ideation among active duty military service personnel?
2. What is the relationship between demographics, combat exposure, lifestyle—activities, lifestyle—nutrition, and lifestyle—stress and mental health issues?
3. Is there a heterogeneous impact of fish oil use on mental health issues by gender and service in particular, the Navy population?

The key findings suggest that fish oil use does not lead to lower incidences of high depression, high PTS, or suicide ideation in service members. In fact, in the most comprehensive model that includes the full range of control variables the fish oil use variables were insignificant. This means that consuming fish oil and not consuming fish oil generate the same odds with regard to the incidence of high depression, high PTS, and suicide ideation among all the services. The results are suggestive of possible reverse causality, in that some people with certain mental health conditions might be advised to take fish oil on a daily basis. Furthermore, Model Five shows that light fish oil use lowered the likelihood of Navy personnel experiencing high PTS in the past 30 days.

The data concerning all services is telling with regard to the control variables. The data shows that personnel who experienced high anxiety and high stress were more likely to develop high incidences of depression, high incidences of PTS, and suicide ideation. Additionally, lifestyle factors can play a major role in mental health conditions. Personnel who were underactive had higher odds of experiencing high levels of depression and PTS. Personnel who were overweight also were more likely to experience suicide ideation. Finally, personnel who performed normal and high strength training had a lower likelihood of experiencing high levels of depression. Moreover, family status may influence the likelihood of high depression incidences and suicide ideation. Personnel who were married experienced lower odds of developing high depressive incidences and suicide ideation in comparison to their single counterparts. Finally, the data unexpectedly shows that personnel who experienced low levels of combat had a lower likelihood of suicide ideation in comparison to those who experienced no combat.

With regard to service members developing high incidences of depression and PTS, the data shows gender plays a role. In fact, the data indicates that women who consumed both light and moderate doses of fish oil developed higher incidences of PTS than men. As well, personnel (both genders) who consumed daily fish oil doses were more likely to seek mental health therapy in the past year in comparison to those who consumed no fish oil. This could be caused by some sort of reverse causality due to the fact that personnel who are seeking mental health therapy may be looking for solutions. These solutions they may be seeking could be medicinal or more alternative in health such as fish oil supplements. Finally, with regard to Navy population, the data shows that combat exposure control variables became significant in mental health therapy. The data indicates that Navy personnel who experienced low and high combat levels had a greater likelihood to seek mental health therapy than non-combat Navy personnel. As well, Navy personnel who deployed in the past year, combat and non-combat, were more likely to have suicide ideation but less likely to seek mental health therapy. Finally, Navy personnel who consumed daily supplements, not fish oil, were less likely to experience high depression and high PTS.

It is important to keep in mind the following limitations when interpreting results from this study. The data might have produced different results with regard to fish oil use if the main question in the study had been more explicit. The question only asked how often a person consumed fish oil in the past 12 months. The answer choices were "two or more times a day," "once a day," "every other day," "once a week," "once a month," and "never in past year" (DOD 2011 Health Related Behaviors Survey, 2011, p. 38). It did not differentiate the actual dosage nor did it differentiate the quality of the fish oil. A more effective approach might determine the specific fish oil dosage. However, this dosage alone would not be sufficient, because the effective part of fish oil is the percentage of DHA and EPA in each dose. A person could take a large dose of fish oil, but the amount of DHA and EPA in the dose might still be small. The DHA and EPA in the fish oil provide key neurological benefits.

Second, one common problem with surveys is that participants can lie or may not remember how often they took their supplements or consumed sweets and fried foods. Likewise, the responses of mental health symptoms are voluntary and self-reported, thereby are subject to recalling errors. Therefore, the results depend largely on participants' truthfulness and their memories. Lastly, the survey questions did not allow me to explicitly test for reverse causality even though the results are suggestive of this possible mechanism. As such, the results from this thesis should be interpreted as merely establishing association from cross-sectional data, and additional works should focus on teasing out the causality in the general military population.

I make the following recommendations based on the research presented in my thesis:

1. Analyze the survey data across all years it has been given to see if there are trends. Since the survey is in its eleventh year of issuance, the data collected over the last eleven years should be compiled, and regressions should be run across all eleven years to identify trends. Have deployments consistently played a part in mental health issues, or only recently? Have stress and anxiety levels increased or decreased over this period? Have the number of personnel who state they have high depression or high PTS increased or decreased over the years?

2. Encourage the military to place more emphasis on lifestyle choices pertaining to health and nutrition. It seems self-evident that military members would be healthy because they are required to pass physical readiness tests and work out a certain number of minutes per week. However, those activities are not enough; more of an emphasis needs to be placed on a culture of fitness. Dining halls need to provide more nutritious options, and MREs need to be better fortified with essential vitamins (Coulter, 2014, p. 195). Military members who would like to take vitamins and other health supplements should be given them for free just like an antibiotic prescription. The military culture itself needs to embrace preventative medicine.

3. Urge the military to help service members with stress and anxiety. Between work and personal responsibilities, military members are stressed, and many do not have proper coping mechanisms. More of an emphasis needs to be placed on alleviating stress among our service personnel. Such options include chiropractic care, massage therapy, and yoga/meditation courses. These alternative health methods will provide ways for our service members to cope with their stress and anxiety, thereby generating positive health benefits.

If this thesis at least continues the conversation regarding healthy lifestyle and preventative healthcare options for our service members, than I will feel successful. The military needs to place more of a priority on preventative healthcare and not rely on symptom treatments alone. For all our service members have done, we owe this to them. Not only service members, but society triumphs if our military is performing at its peak, both physically and mentally.

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